

# **HUMAN HEALTH & DISEASE**

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## **Human health and disease :**

- ✓ Discovery of blood circulation – William Harvey

- ✓ Health is affected by –

1. Genetic disorder

2. Infection

3. Life style – food and water, rest, exercise, habits that we have or lack

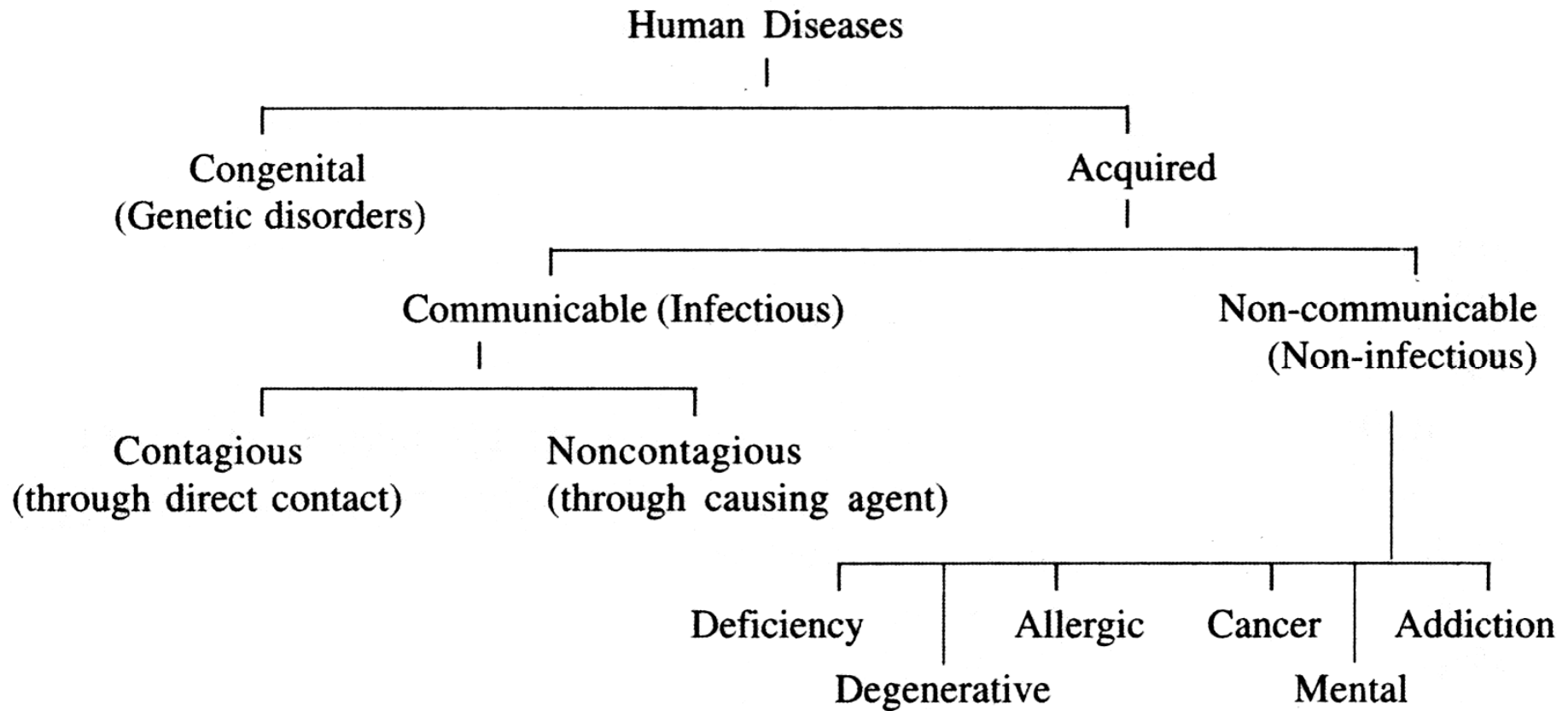
- ✓ Health – state of complete physical, mental and social well being (not nearly absence of disease or physical fitness)

- ✓ Healthy people – more efficient at work – increases productivity – brings economic prosperity, increases longevity of people and reduces infant and maternal mortality

- ✓ Balance diet, personal hygiene, yoga, awareness about diseases, vaccination, proper waste disposal, control of vectors, maintenance of hygienic food and water resources-essential for good health

## ➤ **Common diseases in human:**

- ✓ Pathogens – disease causing organism
- ✓ Pathogens have to adapt to life within environment of host .eg. pathogens entering gut must survive at low pH of stomach and resist digestive enzymes



## ➤ **Bacterial diseases –**

### 1. Diphtheria-

- ✓ *Corynebacterium diphtheriae*
- ✓ Affects children (1-5 years)
- ✓ Effects mucus membrane of nose, throat, tonsil – pseudomembrane formation – child dies due to suffocation
- ✓ Transmission – air droplet
- ✓ Symptoms - high grade fever, sore throat, cough, difficulty in breathing
- ✓ Prevention- DPT / triple vaccine
- ✓ Treatment – anti – diphtheria serum (passive immunity), antibiotics
- ✓ Diagnosis – Schick test

## 2. Leprosy / Hansen's disease

- ✓ *Mycobacterium leprae*
- ✓ Chronic disease (I.P 2-5 years)
- ✓ Effects skin, mucus membrane and peripheral nerves
- ✓ Transmission – by prolonged contact
- ✓ Dx – lepromin test
- ✓ Treatment – Dapsone

## 3. Pertussis / whooping cough –

- ✓ *Bordetella pertussis*
- ✓ Effects children
- ✓ Severe cough with sharp whoop (intense inspiratory sound)
- ✓ Effects respiratory passage, death due to suffocation
- ✓ Prevention- DPT vaccine

#### 4. Pneumonia –

- ✓ Streptococcus pneumonia and haemophilus influenza
- ✓ effects alveoli of lungs – gets fluid filled- severe problems in respiration
- ✓ Symptoms – fever, chills, cough, headache
- ✓ In severe case, lips and finger nails turn grey to bluish (cyanosis)
- ✓ Transmission - by air droplet/ aerosols released by infected person or even by sharing glasses and utensils with infected person
- ✓ Prevention- pneumococcal vaccine

## 5. Scarlet fever :

- ✓ Streptococcus pyogenes
- ✓ Effects URI and pharynx
- ✓ Transmission- air droplet
- ✓ goose pimples / rash on skin
- ✓ Dx- DICK test

## 6. Tetanus / lock jaw disease :

- ✓ Clostridium tetani (anaerobic)
- ✓ Lives on rusted object, soil
- ✓ Transmission – open wound/ improperly sterilized surgical instruments
- ✓ Release neurotoxin – tetanospasmin – attacks (NMJ)
- ✓ Effects mainly skeletal/ voluntary muscle (stiff neck, lock jaws etc)
- ✓ Prevention – DPT vaccine (active immunity) before cut
- ✓ After cut – anti -tetanus serum (passive immunity)



7. TB / tuberculosis/ consumption disease/ koch's disease –

- ✓ Mycobacterium tuberculosis
- ✓ Effects lungs, lymph nodes, intestine, bone, spine (pott's disease)
- ✓ transmission – air droplets
- ✓ Dx- montaux test
- ✓ Toxin released – tuberculin
- ✓ Prevention – BCG vaccine (Bacillus Callmette Guerien)
- ✓ T/t – DOTS
- ✓ World TB day – 24 March

## 8. Typhoid /enteric fever –

- ✓ *Salmonella typhi*
- ✓ enters small intestine through contaminated food and water, migrate to other organs through blood
- ✓ Symptoms – sustain high fever (39° to 40°C), weakness, stomach pain, constipation, headache, loss of appetite
- ✓ Severe case – intestinal perforation and death
- ✓ Prevention – personal hygiene and proper sanitation
- ✓ Dx- widal test
- ✓ Mary Mallon, nicknamed Typhoid Mary (cook by profession, a typhoid carrier, who spread disease for several years through food she prepares)

## **9. Bubonic plague/ black death disease -**

- ✓ Disease of rodents/ rats
- ✓ *Yersinia pestis*
- ✓ Transmission – by rat flea / *Xenopsylla cheopis* (blood sucking parasite on rat)
- ✓ Man infected incidentally
- ✓ Painful bubo in groin and arm pits(enlargement of lymph nodes)
- ✓ Dx- Wayson stain test

## **10. Cholera -**

- ✓ *Vibrio cholerae*
- ✓ Acute diarrhoeal disease (white, rice -water like loose motions)
- ✓ Lives in intestine
- ✓ Transmission- by contaminated food and water
- ✓ T/t – oral rehydration solution (ORS)

## **Some other bacterial disease –**

- Chancroid, gonorrhea, Chlamydia, syphilis (STD)
- Botulism/ food poisoning – *Clostridium botulinum* (anerobic)
  - ✓ Transmission – feco-oral route, lives in intestine
  - ✓ Produced exotoxin in environment (neurotoxin, bio weapon)
  - ✓ Prevention- proper heating of food
- Anthrax – *Bacillus anthracis* (spore forming)
  - ✓ Transmission – spores of bacteria through domesticated animal
  - ✓ Prevention – vaccine (Louis Pasteur)

- Dysentery /shigellosis :
  - ✓ *Shigella dysenterae*
  - ✓ Transmission – feco- oral
  - ✓ Lives in intestine
  - ✓ Oral rehydration therapy given
  - ✓ Bacteria causing diarrhea – *E.coli*, campylobacter, salmonella
- Note : Dx for syphilis – TPI / VDRL / FTA – Ab test / wassermans test
- In syphilis – hutchinsons teeth ,called french pox
- **Rickettsial diseases –**
  1. Q- fever (*Coxiella burnetii*)
  2. Rocky mountain spotted fever (*Rickettsia rickettsii*)
  3. Typhus fever/ epidemic typhus (*Rickettsia prowazekii*) - Dx- well felix test

Name of STD	Pathogen
(1) Gonorrhoea	<b><i>Neisseria gonorrhoeae</i></b> (bacterium)
(2) Genital herpes	<b><i>Herpes simplex</i></b> virus
(3) Genital warts	<b><i>Human papilloma</i></b> virus
(4) Syphilis	<b><i>Treponema pallidum</i></b> (bacterium)
(5) Trichomoniasis	<b><i>Trichomonas vaginalis</i></b> (protozoan)
(6) Chlamydiasis	<b><i>Chlamydia trachomatis</i></b> (bacterium)

**(A) Diseases Caused by Flat Worms**

Disease	Pathogen	Site of Infection	Mode of Infection	Secondary Host	Effect
1. <b>Fasciolopsiasis</b>	<i>Fasciolopsis buski</i> – The Intestinal Fluke	Small Intestine of man	Metacercariae on water plants	<i>Segmentina</i> or <i>Planorbis</i> (snails)	Intestinal inflammation, ulcer, diarrhoea
2. <b>Schistosomiasis</b> <i>bilharzia</i> <i>Snail fever</i>	<i>Schistosoma haematobium</i> (Blood fluke)	Portal and mesenteric veins of man	(larva) Cercariae in water penetrate the skin when come in contact	<i>Bulinus</i> or <i>Melania</i> (snails) <i>fresh water</i>	Urinogenital schistosomiasis
3. <b>Taeniasis</b>	<i>Taenia solium</i> (Pork tapeworm)	Small Intestine of man	By eating ill cooked meaty pork	Pig	Taeniasis (intestinal disorders)
4. <b>Taeniasis</b>	<i>Taenia saginata</i> (Beef tapeworm)	Small Intestine of man	By eating ill cooked beef	Cattle	Intestinal disorders & anaemia
5. <b>Cysticercosis</b> It is more dangerous than taeniasis	<i>Cysticercus</i> (larva of tapeworm)	Ingestion of eggs or oncospheres reach the stomach from intestine by antiperistalsis of intestine where oncospheres (larvae) develop into cysticerci (larvae). From stomach cysticerci reach the eyes and brain	Ingestion of eggs of tapeworm or they reach lower part of digestive tract and develop into cysticerci & reach the eyes and brain	Man	In the eye cysticercus can cause blindness & in the brain it can cause epilepsy
6. <b>Hydatid Disease</b>	<i>Echinococcus granulosus</i> (Dog tapeworm or Hydatid worm)	In the intestine of dogs, cats, foxes and men	By playing with pet dogs.	Man, sheep, goat, pig and cat	The parasite liberates toxins which have harmful effect on the body & brain of the host



### (b) Other Diseases Caused by Round Worms

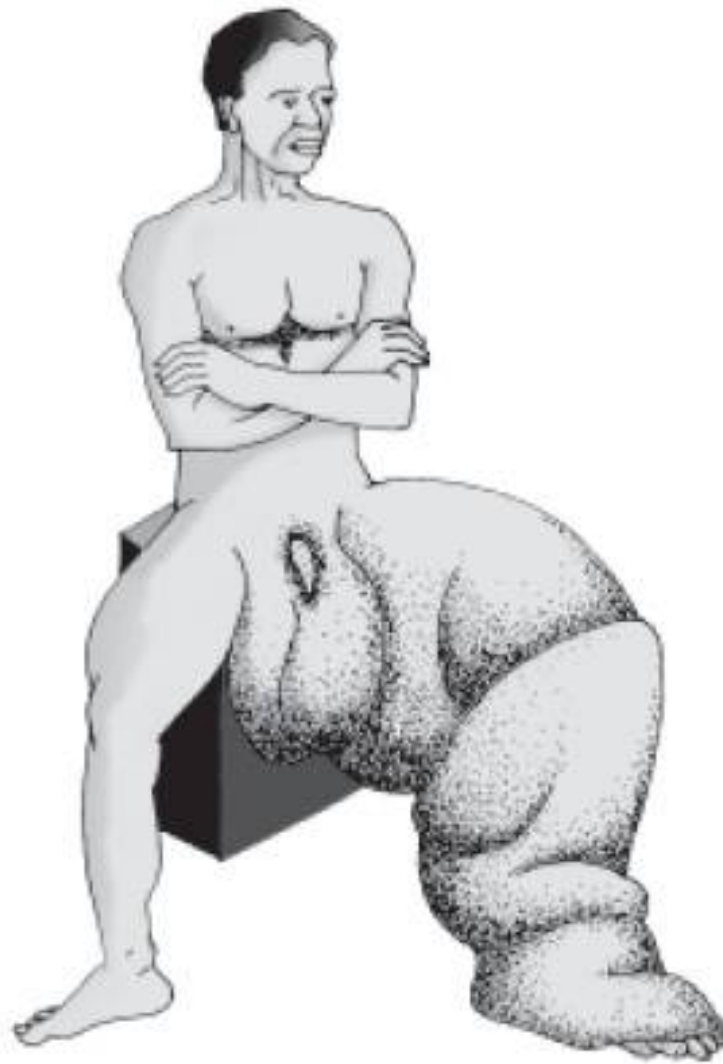
Disease	Pathogen	Site of Infection	Mode of Infection	Effect
1. <b>Ancylostomiasis</b>	<i>Ancylostoma duodenale</i> (Hookworm)	Small Intestine	Larvae bore through the skin of feet	Itching and Inflammation of skin, anaemia, mental & physical deficiency
2. <b>Enterobiasis (Oxyuriasis)</b>	<i>Enterobius vermicularis</i> (Pin worm)	Caecum & Colon appendix	By swallowing eggs with food	Anal itching, appendicitis, nervous trouble
3. <b>Trichinellosis</b>	<i>Trichinella spiralis</i> (Trichina worm)	Encysted larvae in striated muscles, adults in intestine	By eating half cooked infected pork	Muscular pain, pneumonia
4. <b>Dracunculiasis</b>	<i>Dracunculus medinensis</i> (Guinea worm)	Subcutaneous tissue	Taking infected <i>Cyclops</i> with water	Ulcers, diarrhoea, asthma, giddiness
5. <b>Trichuriasis</b>	<i>Trichuris trichiura</i> (Whipworm)	Caecum and appendix	By taking eggs with food	Abdominal pain, anaemia, bloody stools
6. <b>Loiasis</b> (Eye worm disease)	<i>Loa Loa</i> (Eye worm)	Subcutaneous tissue of eyes	By bite of infected deerfly ( <i>Chrysops</i> )	Conjunctivitis

## 1. **Ascariasis** –

- ✓ lumbricoides (monogenetic parasite of human small intestine)
- ✓ Symptoms – internal bleeding, muscular pain, fever, anaemia and blockage of intestinal passage
- ✓ Transmission – by food and water contaminated with embryonated eggs (second stage juvenile eggs is the infective stage)
- ✓ The eggs of parasite are excreted along with faeces of infected persons which contaminate soil, water, plants etc.
- ✓ More common in children
- ✓ T/t – zentel (metronidazole), deworming (anti-helminthic drugs), alcopar, chenopodium oil

## 2. Filariasis /elephantiasis -

- ✓ *Wuchereria bancrofti* and *W.malayi* (digenetic – human and female culex mosquito)
- ✓ Transmission- by bite of female culex mosquito
- ✓ Lives in lymphatic system
- ✓ Slowly develops chronic inflammation of the organs in which they live for many years, usually lymphatic vessels of lower limbs and genitals – gross deformities



**Figure 8.2** Diagram showing inflammation in one of the lower limbs due to elephantiasis

## ➤ **Viral diseases -**

### 1. Small pox- variola virus (ds DNA)

- ✓ Rash on face / limbs from day 3 (more than on trunk)
- ✓ Scar remains
- ✓ First eradicated disease in the world
- ✓ Vaccine – Edward Jenner (1798)
- ✓ Bio weapon
- ✓ Transmission – air droplet / direct contact/ fomite

### 2. Chicken pox -varicella zoster virus (ds DNA)

- ✓ Mainly effect children
- ✓ Transmission as above
- ✓ No scar remains

- ✓ Rash more on trunk, arise in crops, every crop accompanied by fever (dew droplets on rose petal appearance)
- ✓ Vaccine available
- ✓ Late complication – shingles/ herpes zoster (reactivation)

### 3. Measles - paramyxovirus /rubeola virus (ss RNA)

- ✓ Mainly effects children
- ✓ Transmission as above
- ✓ Running nose, watery eyes, pinkish rash on skin etc
- ✓ Koplik's spots inside
- ✓ Vaccine – MMR

4. Rubella / german measles – rubella virus (ss RNA)
  - ✓ Transmission as above
  - ✓ Symptoms like measles but fainter rashes
  - ✓ Vaccine- (MMR)
5. Rabies / hydrophobia disease – rabies / rhabdovirus
  - ✓ Transmission – bite of rabied dog, 100 % fatal disease after symptoms appear
  - ✓ Prevention – vaccine (active) and immune globulin (passive)
6. Herpes – Herpes simplex virus
  - ✓ Genital herpes – HSV II
  - ✓ Cold sore / oral ulcer – HSV I
7. Genital warts – HPV

## 8. Influenza /FLU :

- ✓ Orthomyxovirus
- ✓ Symptoms- nasal congestion, discharge, cough, fever, muscle and joint pain etc
- ✓ Effects nose, throat, URI
- ✓ Late complication – pneumonia, bronchitis , ear infection
- ✓ Vaccine available
- ✓ Swine flu – type A influenza virus (H<sub>1</sub> N<sub>1</sub>)



## 9. Common cold/rhinitis –

- ✓ Rhino viruses (RNA)
- ✓ Infect nose and respiratory passage but not lungs
- ✓ Transmission – droplets from cough or sneezes of an infected person, inhaled directly or through contaminated objects like pens, books, cups, etc
- ✓ Symptoms- nasal congestion and discharge, sore throat, hoarseness, cough, headache, tiredness etc (last for 3-7 days)
- ✓ Highly infectious disease

## 10. Yellow fever :

- ✓ Flavivirus (ss RNA)
- ✓ Transmission- bite of female *Aedes aegypti* mosquito (arthropod- borne disease)
- ✓ Vaccine available

## 11. Dengue / break bone fever:

- ✓ Flavi ribo virus (ss RNA)
- ✓ Transmission as above
- ✓ Mosquito breeds in clean water and bite only during day time
- ✓ Classical dengue fever, haemorrhagic dengue fever (bleeding , low platelet count)
- ✓ Dx – PCR, tourniquette test
- ✓ Aspirin /disprin to be avoided

## 12. Chikunguniya – chikunguniya virus

- ✓ Transmission – as above
- ✓ Symptoms – acute high fever , crippling joint pain
- ✓ Vaccine not available

### 13. Polio / poliomyelitis / infantile paralysis –

- ✓ Occur at any age
- ✓ Polio virus (ss-RNA)
- ✓ Transmission – feco- oral route
- ✓ Multiplies in intestine , travels via blood and effects CNS (motor nerve fibres / ventral root of spinal cord) - paralysis of skeletal muscles
- ✓ Prevention –
  - Injectable polio vaccine (IPV)- by Salk, killed virus
  - Oral polio vaccine (OPV) by Sabin, live attenuated virus

## 14. Mumps –

- ✓ Mumps virus/ paramyxovirus (RNA)
- ✓ Inflammation of parotid salivary gland (lies just below ear lobule)
- ✓ Transmission – Air droplet (virus lives in saliva)
- ✓ Complication – orchitis- sterility
- ✓ Prevention – MMR vaccine

## 15. Hepatitis – inflammation of liver

Liver enlargement – liver shrinks, jaundice etc

1. Hepatitis A- HAV – ssRNA- feco- oral route – acute- vaccine +
2. Hepatitis E- HEV – ssRNA – feco- oral – acute – high mortality in pregnant women- vaccine not available

3. Hepatitis B- HBV- dsDNA-acute – chronic – cirrhosis/liver cancer – rDNA vaccine
  - ✓ Transmission – sexual contact (incurable STD), blood transfusion, sharing of infected needle, mother to fetus during pregnancy and child birth (cross placenta)
4. Hepatitis C- HCV – ss RNA- acute – chronic – liver cancer – vaccine not available
  - ✓ Through blood transfusion and sharing of infected needles
5. Hepatitis D – HDV – ssRNA – co- infection with HBV is must – vaccine +
  - ✓ Transmission as HBV

## Characteristic Features of Different Types of Hepatitis

Feature	*Hepatitis A	Hepatitis B	Hepatitis C	Heptatitis D	Hepatitis E
1. Name of virus	HAV	HBV	HCV	HDV	HEV
2. Nucleic Acid present in virus	RNA	DNA	RNA	RNA	RNA
3. Transmission	Faecal oral Route	*Parenteral; (Blood, Needle, Body secretion, Placenta, Sexual contact)	Parenteral; (Blood)	Parenteral; (Blood, coinfection with hepatitis B)	Faecal oral Route
4. Symptoms	Fever, headache, gastro intestinal disturbance, dark urine, jaundice	Similar, to HAV but no headache. Severe liver damage, yellowish eyes, light coloured stools,	Similar to HBV more likely to become chronic	Severe liver damage, high mortality rate	Similar to HAV but pregnant women may have high mortality
5. Incubation Period	2-6 weeks	6 weeks-6 months	2-22 weeks	6-26 weeks	2-6 weeks
6. Vaccine	Hepatitis A virus vaccine	Genetically modified vaccine	No	HBV vaccine is protective	No
7. Chronic Hepatitis	None	Yes	Yes	Yes	No

<b>Virus</b>	<b>Genome</b>	<b>Mode of Transmission</b>
HAV	ssRNA	Faeco-oral
HBV	dsDNA	Blood, sexual contact
HCV	ssRNA	Blood, sexual contact
HDV	ssRNA	Blood, sexual contact
HEV	ssRNA	Faeco-oral

## ➤ **Protozoal diseases:**

### 1. Giardiasis -

- ✓ *Giardia intestinalis*/ *G.lambia* (flagellated)
- ✓ Found in upper SI
- ✓ Monogenetic parasite, called grand old man of human intestine
- ✓ Diarrhoea , N and V, dehydration, weakness etc
- ✓ Transmission- feco -oral root
- ✓ T/t – anti- protozoal drugs

### 2. Trichomoniasis / leucorrhoea -

- ✓ *Trichomonas vaginalis* (flagellated)
- ✓ Found in vagina
- ✓ Transmission- unprotected coitus (STD)
- ✓ Prevention- use of condoms



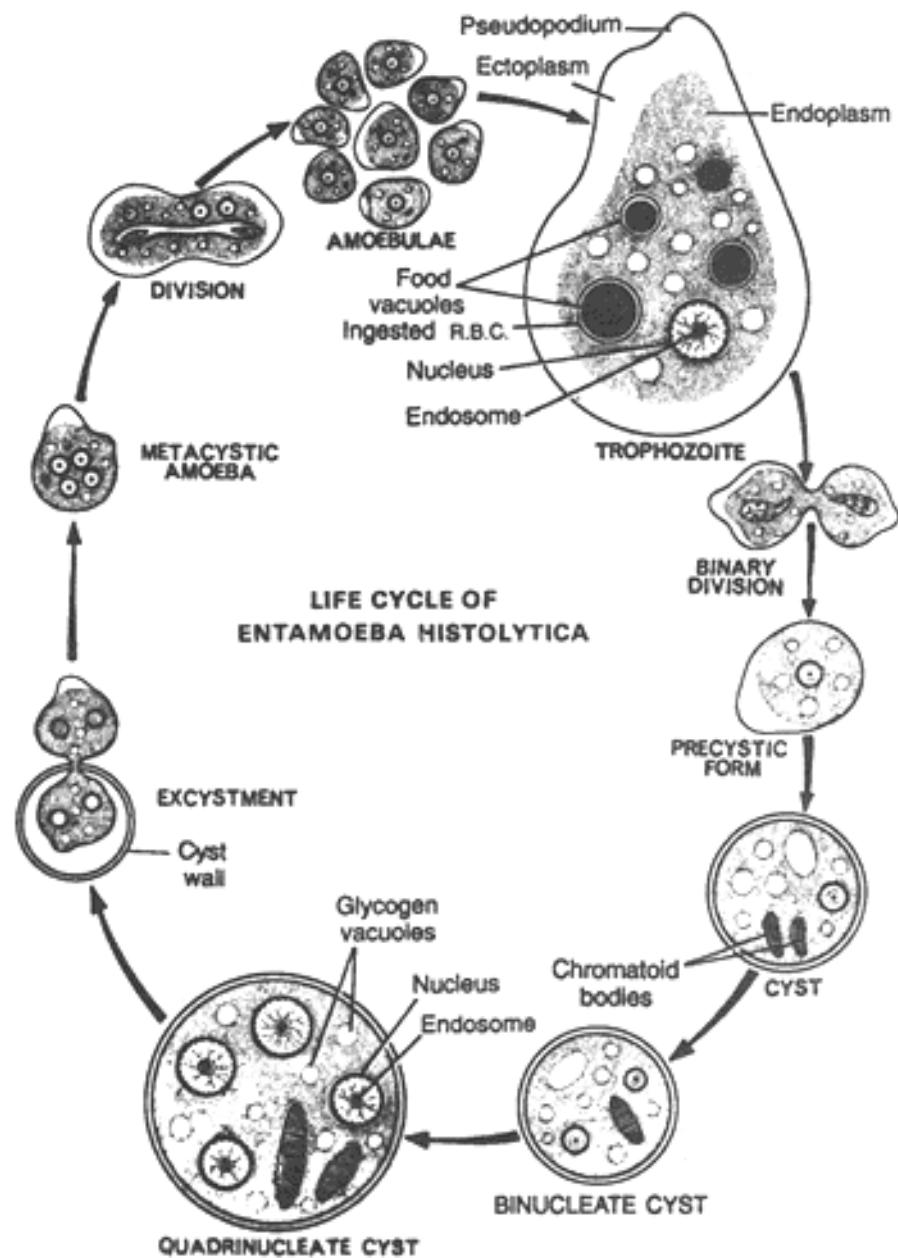
3. African sleeping sickness-
  - ✓ *Trypanosoma gambiense*
  - ✓ By bite of tse- tse fly/ *Glossina palpalis*
4. Chagas disease -
  - ✓ *T.cruzi* (American)
  - ✓ By Bite of triatoma bug /kissing bug (fecal matter)
5. Kala azar / dum- dum fever / visceral leishmani-asis
  - ✓ *L.donovani*
  - ✓ By bite of sand fly/ *Phlebotomus*
  - ✓ Most dangerous form
6. Cutaneous leishmaniasis/ Delhi boils/ Baghdad sores/ oriental sore- *L.tropica*
7. Muco – cutaneous/ naso- oral/ Espundia disease – *L.brasillensis*

## 8. Pyorrhea –

- ✓ *Entamoeba gingivalis* (monogenetic)
- ✓ By exchange of saliva (sharing of utensils, kissing)
- ✓ Infective stage – trophozoite (adult), does not form cyst

## 9. Amebiasis (amoebic dysentery) -

- ✓ *Entamoeba histolytica* (monogenetic, in large intestine of human)
- ✓ Symptoms – constipation, abdominal pain and cramps stools with excess mucus and blood clots
- ✓ Transmission – houseflies acts as mechanical carriers and serve to transmit parasite from faeces of infected person to food, contaminating them.
- ✓ Drinking water and food contaminated by fecal matter – main source of infection



*Entamoeba histolytica* : Reproductive and life history

## **Adult – 2 forms**

1. Magna form – pathogenic (found in mucosa and sub-mucosa of intestinal wall and cause ulcers)
2. Minuta form – non- pathogenic (lives in lumen of intestine, forms cyst – TNC- infective stage)
  - ✓ One TNC gives rise to eight amoebulae

## 10. Balantidiasis –

- ✓ B.coli (monogenetic ciliated, LI of human)
- ✓ Transmission by contaminated food and water with cyst

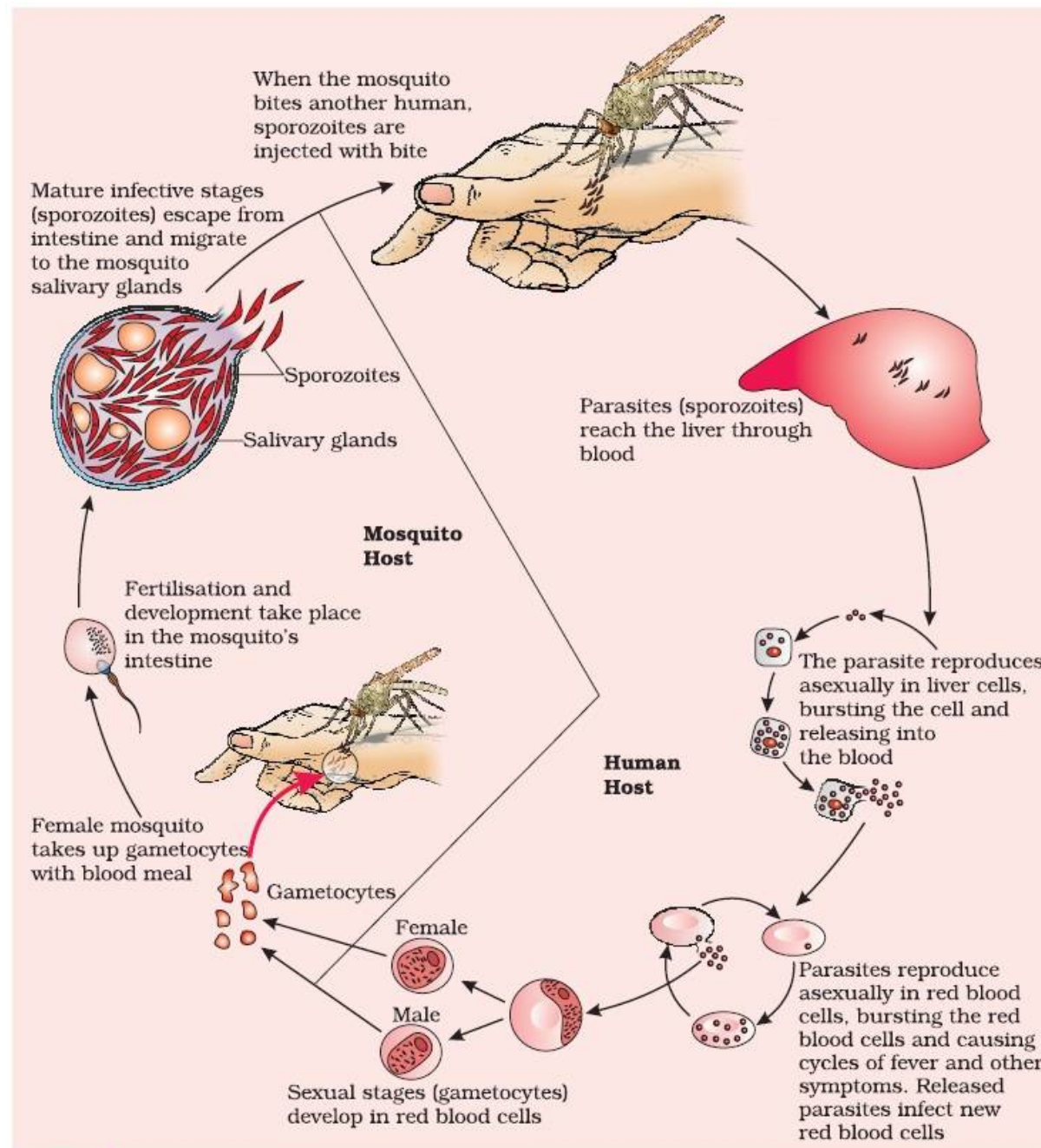
## 11. Babesia , Eimeria, Nosema, Monocystis

- ✓ Germ theory of disease- by Louis Pasteur
- ✓ Koch's postulates – by Robert Koch, establishes relation between pathogen and disease (exception viruses, mycobacterium leprae)

## ➤ **Malaria:**

- ✓ Plasmodium
- ✓ Digenetic – human and female anopheles mosquito
- ✓ In human - schizogony in liver and RBC (asexual reproduction)
- ✓ In anopheles - gametogony in gut / stomach (sexual reproduction) and sporogony
- ✓ Infective stage- sporozoites in salivary gland of mosquito
- ✓ Plasmodium enters human body as sporozoites (infectious form) through bite of infected female anopheles mosquito

- ✓ Parasites initially multiply within liver cells, then attacks RBC and rupture them – release of toxic haemozoin – responsible for chill and high fever recurring every 3-4 days
- ✓ When mosquito bites infected person, the parasite enters mosquito body and undergo further development
- ✓ Parasite then form sporozoites, stored in salivary glands
- ✓ When these mosquito bite a human, the sporozoites enter his body, initiating above events
- ✓ Prevention – killing of mosquito (best), use of gambusia fish (larvicidal) as bio- control
- ✓ T/t – Quinine (bark of cinchona tree) - natural drug



## TYPES OF MALARIA

<b>Disease</b>	<b>Causative agent</b>
Tertian malaria	<i>Plasmodium vivax</i>
Benign tertian malaria	<i>Plasmodium vivax</i>
Vivax malaria	<i>Plasmodium vivax</i>
Mild tertian malaria	<i>Plasmodium ovale</i>
Ovale malaria	<i>Plasmodium ovale</i>
Subtertian malaria	<i>Plasmodium falciparum</i>
Estivo-autumnal malaria	<i>Plasmodium falciparum</i>
Malignant tertian malaria	<i>Plasmodium falciparum</i>
Cerebral malaria	<i>Plasmodium falciparum</i>
Black water fever	<i>Plasmodium falciparum</i>
Quartan malaria	<i>Plasmodium malariae</i>
Quotidian malaria	Mixed infections



## ➤ **Fungal disease -**

1. Ringworms – one of the most common infectious diseases in man
  - ✓ Microsporum, trichophyton and epidermophyton
  - ✓ Symptoms – appearance of dry, scaly lesions on skin, nails and scalp, intense itching
  - ✓ Heat and moisture helps these fungi to grow , which make them thrive in skin folds , as in groin or between toes
  - ✓ Acquired from soil (taenia pedis/ athlete's foot disease), using towels, clothes or even comb of infected person (taenia capitis/scalp, T.barbae/ facial hair etc.)



**Figure 8.3** Diagram showing ringworm affected area of the skin

➤ Prevention and control of infectious disease :

1. Personal hygiene – keeping body clean, clean drinking water and food
2. Public hygiene – proper disposal of waste and excreta, periodic cleaning and disinfection of water reservoir, pools, tanks and observing standard practices of hygiene in public
3. Air -borne diseases (pneumonia, common cold) - avoid contact with infected persons or their belongings
4. Vector- borne disease (malaria, filariasis, dengue, chikungunya)- control or eliminate vectors and their breeding places (avoid stagnation of water, regular cleaning of household coolers, use of mosquito nets, using larvicidal fishes, insecticide spraying in drainage areas, wire mesh in doors and windows)

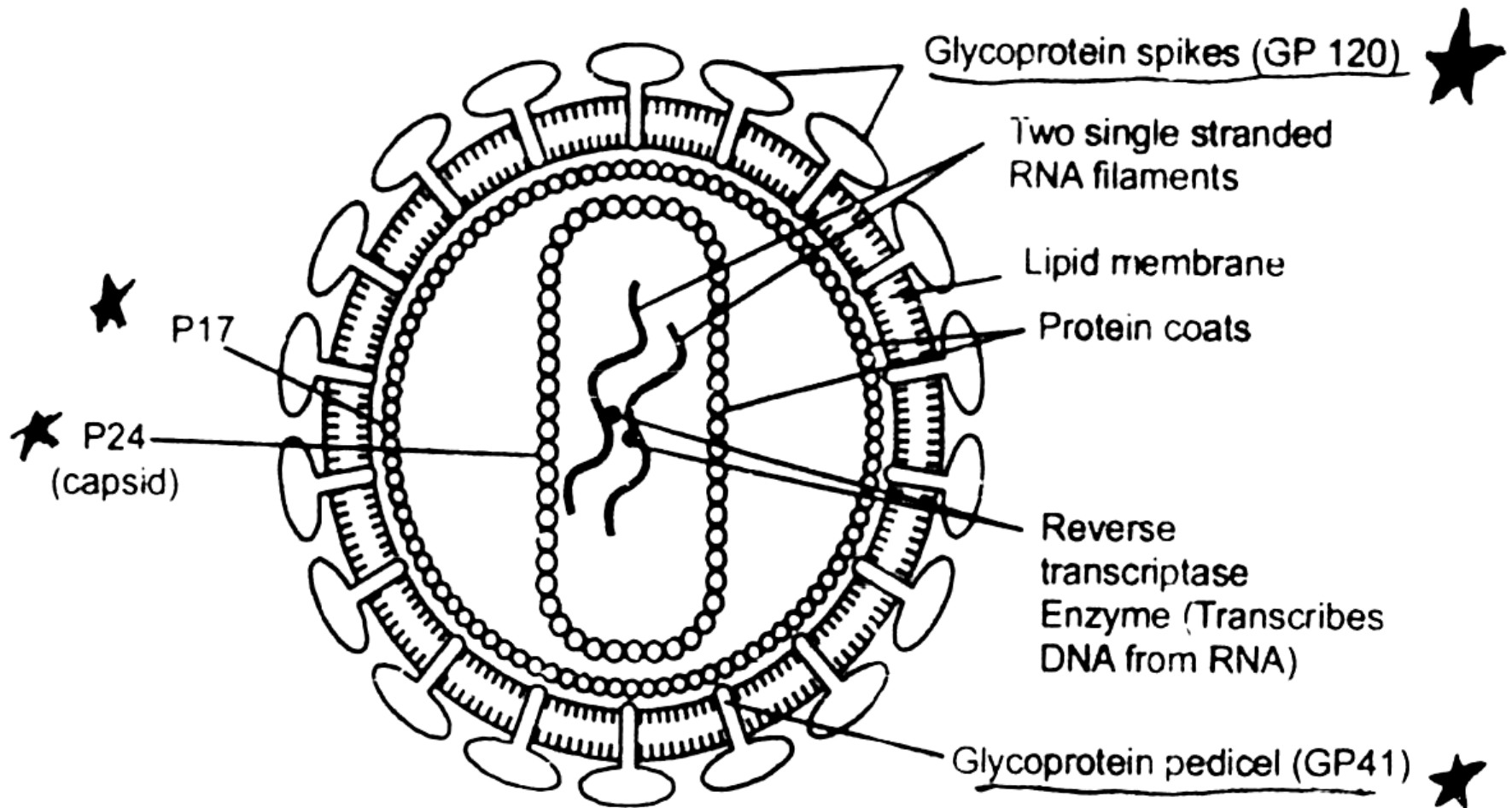
5. Vaccination and immunization programs – completely eradicated small pox (polio, diphtheria, pneumonia, tetanus, controlled to a large extent)
6. Antibiotics –
  - ✓ Term antibiotic- Waksman
  - ✓ First antibiotic discovered – Penicillin by Alexander Fleming (1928), from fungus *Penicillium notatum*
  - ✓ M/A- inhibit cell wall(maximum)/ DNA/ RNA/ proteins synthesis (second maximum)/ anti-metabolite activity
  - ✓ Totally ineffective against viruses as they lack cell structure and metabolic activity

## Some Diseases and Their Confirmatory Tests

	Test	Disease
1.	Schick Test	Diphtheria
2.	Wassermann Test	Syphilis
3.	Widal Test	Typhoid/Paratyphoid
4.	Wayson Stain Test	Bubonic Plague
5.	Lepromin Skin Test	Leprosy
6.	Dick Test	Scarlet Fever
7.	Tourniquet Test	Dengue Fever
8.	Ames Test/Elisa	Carcinogenic Diseases
9.	Mantoux Test	Tuberculosis
10.	R.A. Factor	Rheumatoid Arthritis
11.	Well-Felix Test	Typhus Fever
12.	ELISA (Enzyme— Linked Immunosorbent Assay)	AIDS can be diagnosed by ELISA, Western Blotting Test is employed for confirmation of ELISA positive cases
	ELISA is also used to diagnose Hepatitis B and Hepatitis C	
13.	PCR (Polymerase Chain Reaction)	Genital Herpes, AIDS,
14.	VDRL (Venereal Disease Research Laboratory)	Syphilis
15.	Pap's Test	Cancer of Cervix
16.	Rose-Waaler Test	Rheumatoid Factor (an immunoglobulin present in serum of persons suffering from Rheumatoid arthritis. This is done for test Rheumatoid Factor.

## Human health and disease

- **AIDS** – Acquired Immuno Deficiency Syndrome
  - ✓ Caused by Human Immunodeficiency Virus (HIV)- retrovirus, have an envelope enclosing RNA genome
- ❖ **Structure of HIV:**
  - ✓ ssRNA virus (2 identical filaments) - diploid retrovirus
  - ✓ Enzyme - reverse transcriptase
  - ✓ core has 2 protein coat (inner P<sub>24</sub> /capsid and outer P<sub>17</sub>)
  - ✓ envelope- made of lipoproteins and contains GP-120 and GP- 41



**Fig. :** Diagrammatic representation of HIV

- ✓ GP- 120 has complimentary sequence to CD – 4 receptors present on macro phages (HIV factory) and helper T- cells
- ✓ Deficiency of immune system acquired during life time, i.e. it is not a congenital disease
- ✓ Syndrome means group of symptoms
- ✓ First reported in 1981 (in USA) and in last 25 years, spread all over world killing more than 25 million persons
- ✓ In India – Chennai (1986)



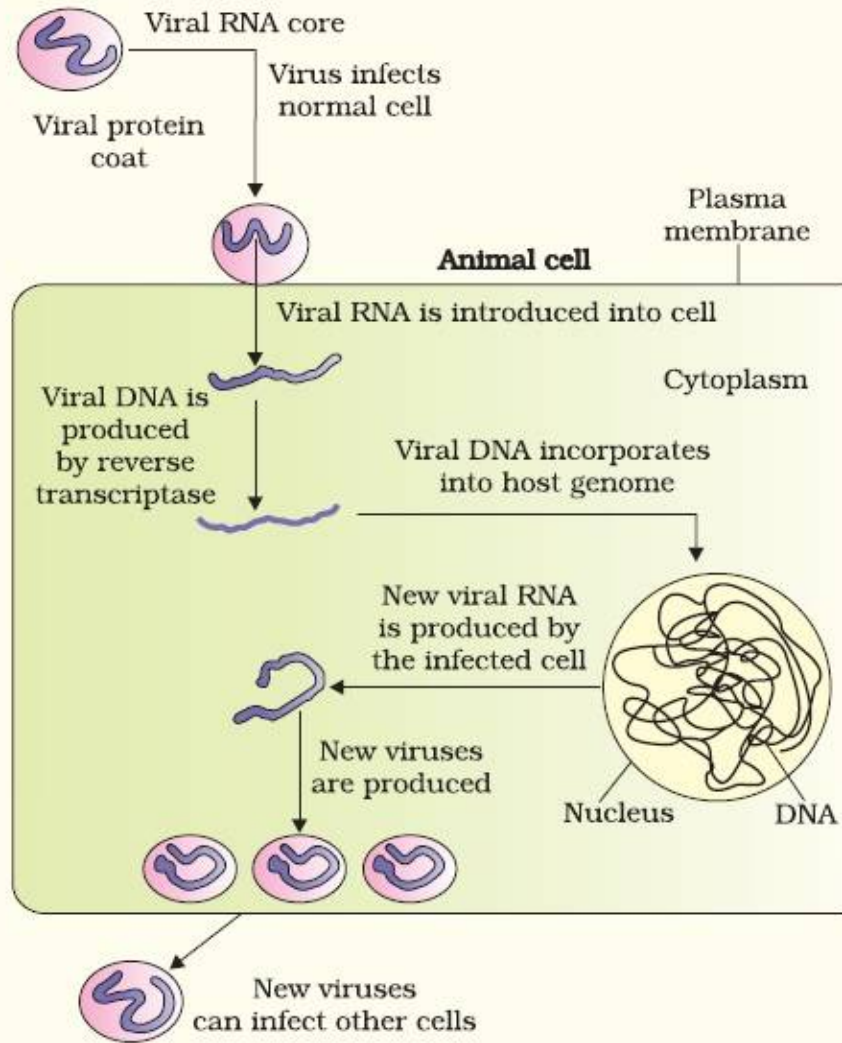
- Mode of transmission – by blood and body fluids
1. Sexual contact with infected person
  2. Transfusion of contaminated blood and blood products
  3. Sharing infected needles, as in case of intravenous drug abusers
  4. From infected mother to her child through placenta (vertical transmission)

**Note:** Does not spread by mere touch or physical contact (kissing, mosquito bite, hugging, touch, sharing objects/ utensils, shaking hands etc), spreads only through body fluids hence should not be isolated from family and society

➤ **At high risk for HIV -**

1. Who have multiple sexual partners
2. Drug addicts, who take drugs intravenously
3. Who require repeated blood transfusion
4. Children born to HIV infected mother

### Retrovirus



NOTE: Infected cell can survive while viruses are being replicated and released

**Figure 8.6** Replication of retrovirus

## **Pathogenecity –**

- ✓ After getting into body, virus enters into macrophages where RNA genome of virus replicates to form viral DNA with help of enzyme reverse transcriptase
- ✓ This viral DNA gets incorporated into host cell's DNA and directs infected cells to produce virus particles
- ✓ Macrophages continue to produce virus (acts as HIV factory)
- ✓ Simultaneously, HIV enters into helper T-lymphocytes ( $T_H$ ,  $CD_4$  receptors), replicated and produce progeny virus

- ✓ The progeny viruses released in blood attack other helper T – lymphocytes
- ✓ This is repeated leading to a progressive decrease in the number of helper T- lymphocytes in the body of infected person
- ✓ Leads to progressive immune deficiency
  - Window period – time lag between infection and clinical diagnosis (1 ½ months )
  - Incubation period – time lag between infection and appearance of AIDS symptoms , few months to many years (usually 5-10 years)

## ➤ Symptoms –

1. Asymptomatic phase –
2. ARC (AIDS Related Complex) - milder form of AIDS, bouts of fever, diarrhea, weight loss etc.
3. AIDS – total collapse of immune system (helper T cells less than  $200 / \text{mm}^3$ )
  - ✓ Person starts suffering from infections that could have been otherwise overcome such as those due to bacteria esp. mycobacterium, viruses, fungi and parasites like toxoplasma, Kaposi sarcoma (opportunistic infections ).
  - ✓ Patients become so immuno deficient that he is unable to protect himself against these infections

➤ **Diagnosis –**

1. ELISA (Enzyme Linked Immuno- Sorbent Assay) – screening test
2. Western blot test (confirmatory test)

➤ **Treatment of AIDS –**

- ✓ With anti- retroviral drugs (blocks conversion of RNA into DNA, drug of choice – Zidovudin / AZT azithrothymidine) is only partially effective. They can only prolong life of patient but cannot prevent death, which is inevitable

- Prevention of AIDS – don't die out ignorance , has no cure hence prevention is the best option
  1. Proper blood testing (making blood banks safe from HIV)
  2. Use of only disposable needles and syringes in public and private hospitals and clinics
  3. Free distributions of condoms
  4. Controlling drug abuse
  5. Advocating safe sex
  6. Promoting regular checkups for HIV in susceptible population
    - ✓ WHO has started a number of program to prevent the spreading of HIV infection



- ✓ National AIDS Control Organization (NACO) and Non – Governmental Organizations (NGOs)
- ✓ World AIDS day – 1<sup>st</sup> December
- ✓ Infection with HIV/AIDS should not be hidden. Need help and sympathy. unless society recognizes it as a problem to be dealt within collective manner -chances of wider spread of disease increase manifold
- ✓ It is malady that can only be tackled by the society and medical fraternity acting together to prevent spread of disease

## ➤ **Cancer :**

- ✓ One of the most dreaded disease of human beings and major cause of death all over globe
- ✓ More than a million Indian suffer from cancer and a large number of them die from it annually.
- ✓ Abnormal and uncontrolled growth and division of cells (break down highly controlled and regulated cell growth and differentiation)
- ✓ Loose property of contact inhibition (normal cells show this property by which contact with other cells inhibits their uncontrolled growth), hence produces masses of cells called “tumors”

## **2 types of tumors-**

1. Benign tumor – remain confined to their original location , do not spread to other body parts (no metastasis), little damage , slow growth
2. Malignant tumor/ neoplastic/ cancerous tumors – tumor cells reach distant sites through blood and wherever they get lodged, starts a new tumor there (metastasis- most feared property of malignant tumors)
  - ✓ Cells grow very rapidly, invading and damaging surrounding normal tissues (very dangerous, tumor cells starve normal cells by competing for nutrients)

### Differences between Benign Tumour and Malignant Tumour

#### *Benign Tumour*

1. It remains confined to the affected organ.
2. Rate of growth is usually slow.
3. There is no latent stage.
4. There is no metastasis.
5. It is non-cancerous.

#### *Malignant tumour*

1. It also spreads to other organs of the body.
2. Rate of growth is usually rapid.
3. There is latent stage.
4. There is metastasis.
5. It is cancerous.

- Types of cancer (basis – tissue of origin)
  1. Carcinoma (85%) - malignant growth of epithelium (ectodermal)
    - ✓ eg. Breast/ lung/ uterus cervical/ skin cancer's etc
    - ✓ Note: - adenocarcinoma (gland tumor)
  2. Sarcomas (1%) - malignant growth of connective tissue (mesodermal)
    - ✓ Eg. Bone (osteosarcoma), muscle (myosarcoma), lymphosarcoma etc
    - ✓ Note : leukaemias and lymphomas (hodgkins and non- hodgkins- 80%) – tumors of haematopoietic cells
    - ✓ Oncology – study of cancer
    - ✓ World cancer day – 4<sup>th</sup> feb

## ➤ **Causes of cancer :**

- ✓ **Note** : cellular oncogenes (c-onc)/ proto-oncogenes are found in normal cells which when activated under certain conditions could lead to oncogenic transformation of cells

### Carcinogens and Organs Affected

<i>Carcinogens</i>	<i>Organs Affected</i>
1. Soot	Skin, lungs
2. Coaltar (3, 4-benzopirene)	Skin, lungs
3. Cigarette smoke (N-nitrosodimenthylene)	Lungs
4. Cadmium Oxide	Prostate gland
5. Aflatoxin (a mould metabolise)	Liver
6. 2-naphthylamine and 4-aminobiphenyl	Urinary bladder
7. Mustard gas	Lungs
8. Nickel and Chromium compounds	Lungs
9. Asbestos	Lungs, pleural membrane
10. Diethylstilbestrol (DES)	Vagina
11. Vinyl chloride (VC)	Liver

➤ Cancer detection and diagnosis- early detection is essential as it allows the disease to be treated successfully

1. Biopsy and histopathological studies of the tissue
2. Blood and bone marrow tests – for increased cell counts in leukemias .
3. Radiography – use of X-RAY
4. CT (computed tomography) - uses X-RAYS to generate 3 – D image of internals of an object
5. MRI (Magnetic Resonance Imaging) – uses strong magnetic fields and non – ionizing radiations to accurately detect pathological and physiological in the living tissue - best technique



6. Monoclonal antibodies – against cancer specific antigens
7. FNAC (Fine Needle Aspiration Cytology)
8. Pap smear – used for Cervical carcinoma
9. Molecular biology techniques – detects genes in individuals with inherited susceptibility to certain cancers .
  - ✓ Identification of such genes helps in prevention by avoiding exposure to susceptible carcinoma (eg. Tobacco smoke in lung cancer)

## ➤ **Treatment of cancer –**

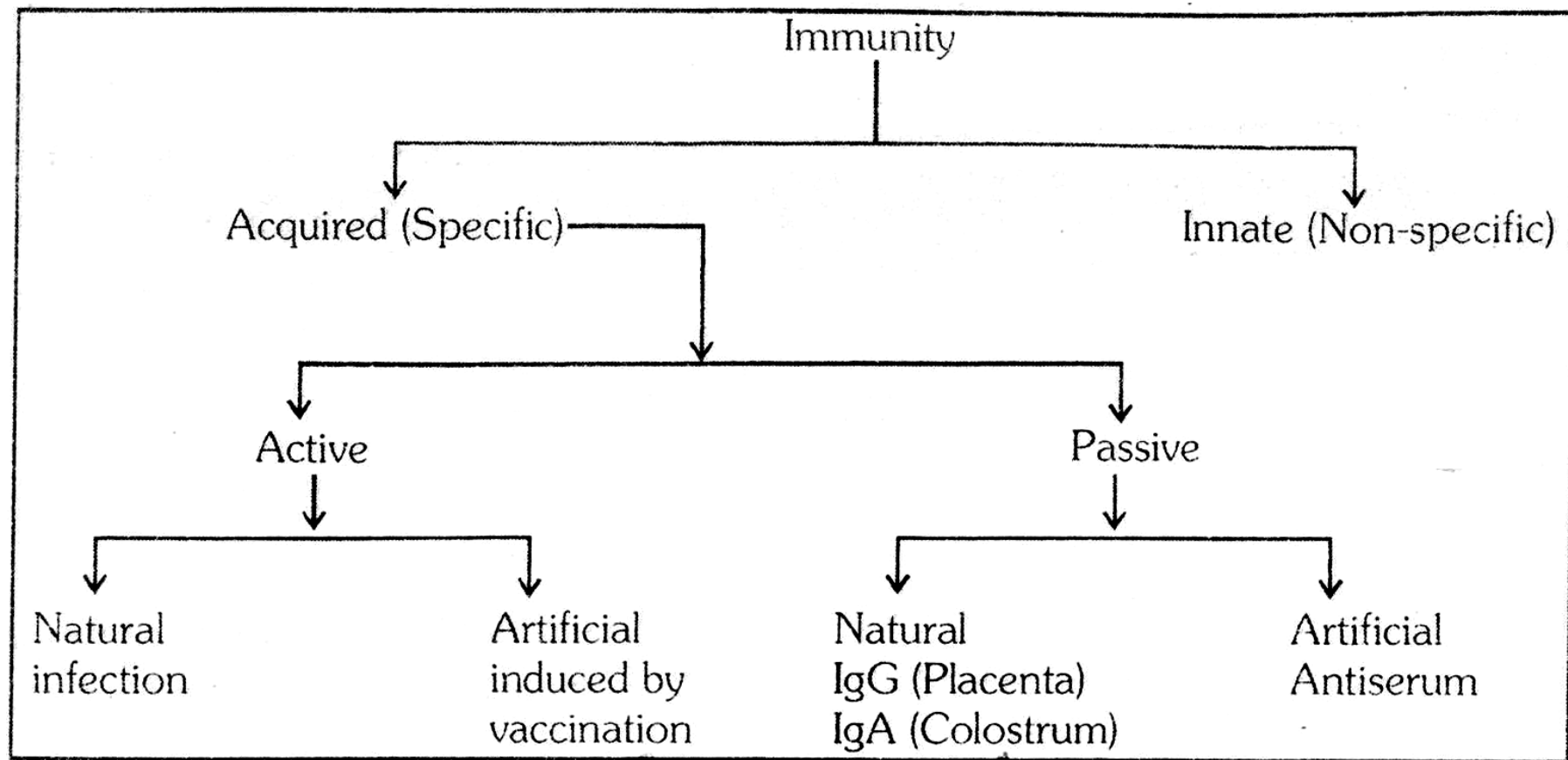
1. Surgery
2. Radiation therapy – tumor cells are irradiated lethally, taking proper care of normal tissues surrounding tumor mass. Eg. I <sup>131</sup> (thyroid cancer)
3. Chemotherapy – drugs kill cancerous cells
  - ✓ Natural anti- cancer drug – vincristine and vinblastin (from *cantharanthus roseus*/vinca roseus)
  - ✓ Side effects – hair loss, anemia etc
  - ✓ Note: most cancers are treated by combination of above 3 therapy
4. Immunotherapy - use of biological response modifiers like alpha interferon, which activate immune system and helps in destroying tumor (tumor cells avoid detection by immune system)
5. Use of inhibitors of TAF (Tissue Angiogenesis Factor)

## ➤ **Immunity :**

- ✓ Overall ability of the host to fight disease causing organisms conferred by immune system – immunity

### 1. Innate immunity/ natural/ inborn/ non specific/ genetic/ familial –

- ✓ Present since birth
- ✓ In both vertebrates and non - vertebrates
- ✓ active throughout life
- ✓ Non- specific type of defence
- ✓ No memory
- ✓ Forms 1<sup>st</sup> and 2<sup>nd</sup> line of defence
- ✓ 4 barriers and a compliment system
- ✓ Comes from parents



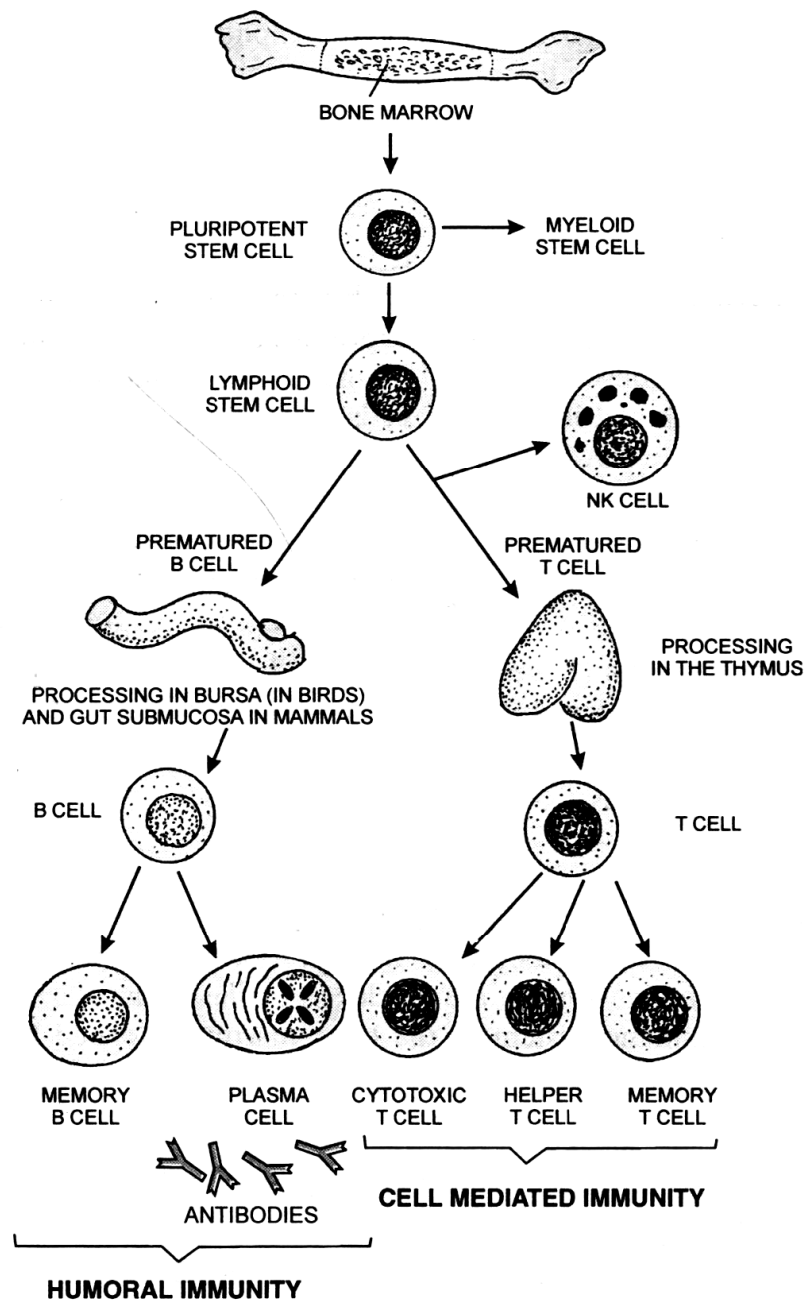


Fig. 8.8. Development of B and T lymphocytes. Both arise from bone marrow precursors. Natural killer (NC) cells are a third population of lymphocytes that are distinct from T cells and B cells.

➤ 4 barriers –  $P_2C_2$

1. Physical – skin (prevents entry of pathogens), mucus coating of epithelium lining respiratory, gastrointestinal and urogenital tract (traps and immobilize microbes entering our body)
2. Physiological –
  - ✓ Specific pH of organs (acidic pH of stomach, vagina, urine), lysozyme (bacteriocidal enzyme in saliva and tear), secretions of sweat and sebum glands of skin
  - ✓ All prevent microbial growth
3. Cellular barrier – phagocytic (monocytes, PMNL-neutrophil, macrophage) and cytotoxic (natural killer cells – destroy virus infected and cancerous cells by secreting perforins and granzymes)

4. Cytokine barrier – proteins /molecules for cell to cell communication

e.g. 1. Interferons – antiviral proteins secreted by virus-infected cells, protects non- infected cells from further viral infection by inhibiting viral replication

2. Interleukin – 1: by leucocytes – produce pyrogen (Induce mild fever) – more WBC multiplication – inhibit bacterial growth

3. Histamine – produce by broken mast cell and basophils, induce vasodilation and diapedesis – inflammatory response

- Blood complement system –
  - ✓ 30 kinds of plasma proteins secreted by liver, circulate in inactive form in blood.
  - ✓ When active – cascade reaction – create transmembrane pore – osmotic imbalance – pathogenic cell swell and burst
  - ✓ Note:- physical and physiological barrier form first line of defense
  - ✓ Cellular and cytokine barriers forms second line of defense



- Acquired immunity :
  - ✓ After birth, pathogen - specific, memory present, forms third line of defense
  - ✓ Main component-:B and T – lymphocytes (also antibodies)
  - ✓ Properties –
    1. Specificity
    2. Diversity
    3. Discrimination between self and non self antigens
    4. Memory –
  - ✓ First encounter with pathogen- primary immune response (low intensity)
  - ✓ Subsequent encounter with same pathogen – secondary/ anamnestic response (highly intensified, due to memory of first encounter)

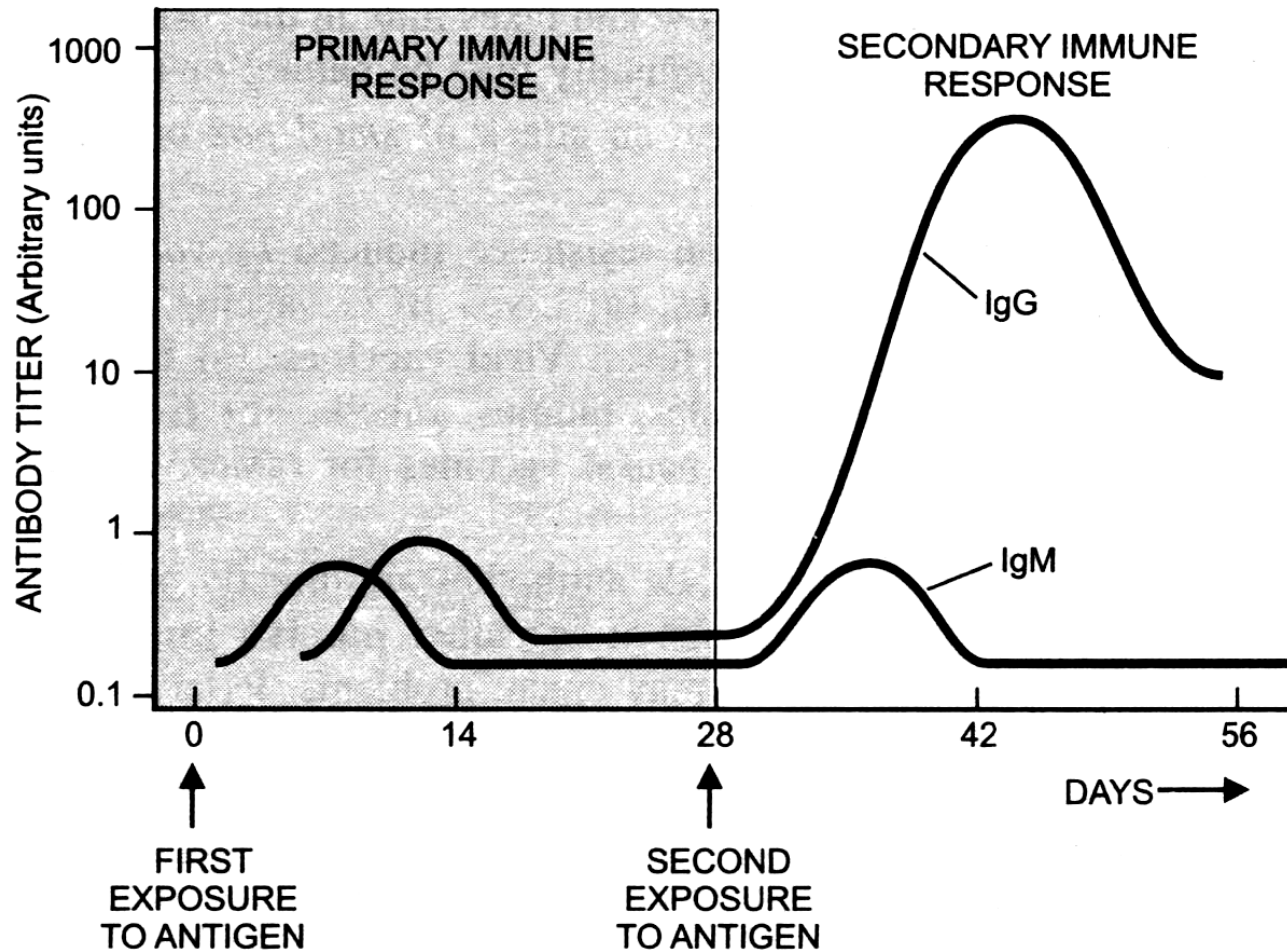


Fig. 8.10. Production of antibodies in the primary and secondary responses to a given antigen.

<b>Primary Immune response</b>	<b>Secondary Immune response</b>
<ol style="list-style-type: none"> <li>1. Encounter with Ag – 1<sup>st</sup> Encounter</li> <li>2. Ab Involved – IgM F/b IgG</li> <li>3. Response – slow</li> <li>4. Ab titre – low</li> </ol>	<ul style="list-style-type: none"> <li>- Subsequent encounter</li> <li>- IgG</li> <li>- Fast</li> <li>- High</li> </ul>

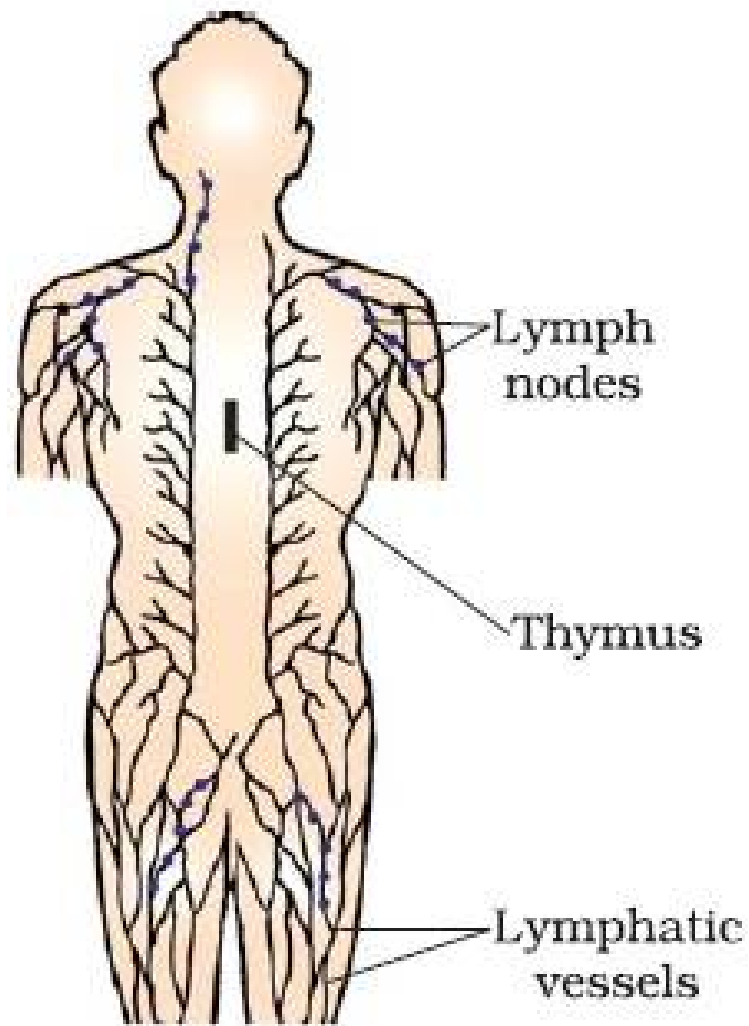
- Immune system in body –
  - ✓ Consist of lymphoid organs, tissues, cells and soluble molecules like antibodies
  - ✓ Unique – recognizes foreign antigens, response to these and remembers them
  - ✓ Important role in allergy reactions, auto - immune diseases and organ transplantations
  - ✓ Lymphoid organs – where origin and/ or maturation and proliferation of lymphocytes occur
- 1. Primary – differentiation and maturation of lymphocytes into antigen -sensitive cells
  - A) bone marrow – origin of all blood cells and maturation of B-lymphocytes
  - B) thymus – maturation of T- lymphocytes

2. Secondary – sites for interaction of lymphocytes with antigens, which then proliferate to become effector cells.

✓ Eg. Spleen, lymph nodes, tonsils, appendix, peyers patches of small intestine (MALT)

## ❖ Note –

- ✓ Spleen – large bean shaped organ, mainly contains lymphocytes and phagocytes, acts as blood filter by trapping blood – borne microorganisms, reservoir of RBC (Blood bank/graveyard of RBC)
- ✓ MALT – lymphoid tissue located within lining of major tracts (respiratory, digestive and urogenital tracts). Called Mucosa Associated Lymphoid Tissue, constitutes 50% of lymphoid tissue in human body
- ✓ Lymph nodes – small solid structures located at different points along lymphatic system, traps microbes or other antigens which gets into lymph and tissue fluid . Antigens in lymph nodes are responsible for activation of lymphocytes present there and cause immune response



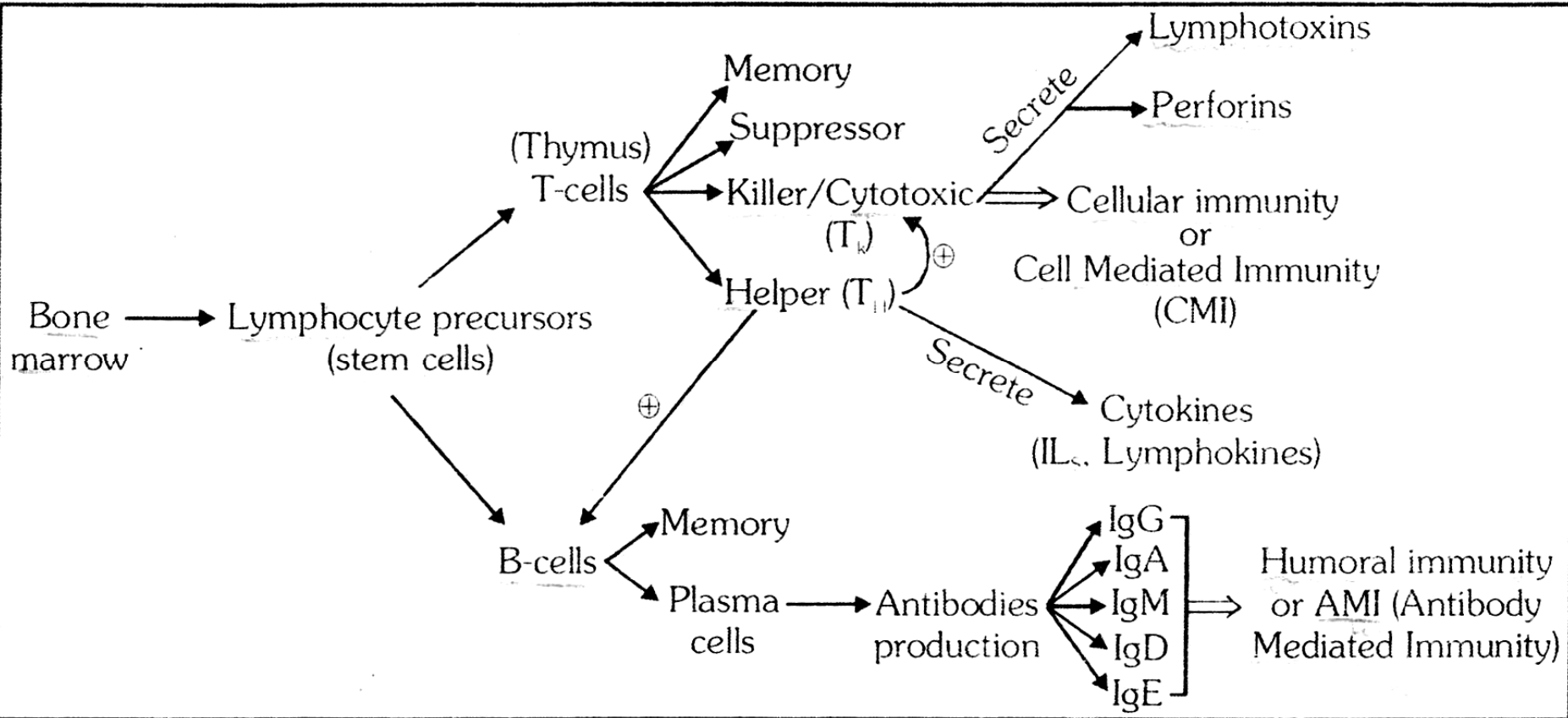
**Figure 8.5** Diagrammatic representation of Lymph nodes

- Components of acquired immunity – CMI and AMI
  - 1. CMI (cell – mediated immunity) - T – Lymphocytes
    - ✓ Immunity against all pathogens/ cancerous cells/ organ transplant/ grafting
    - ✓ T- lymphocytes are formed in bone marrow and mature in thymus
    - ✓ Types of T lymphocytes - helper, killer/ cytotoxic, suppressor and memory T – lymphocytes
    - ✓ Note:- helper T cells/ CD4 cells K/a commander of immune system, role in both CMI and AMI, attacked by HIV, starts graft rejections, induced compliment activation

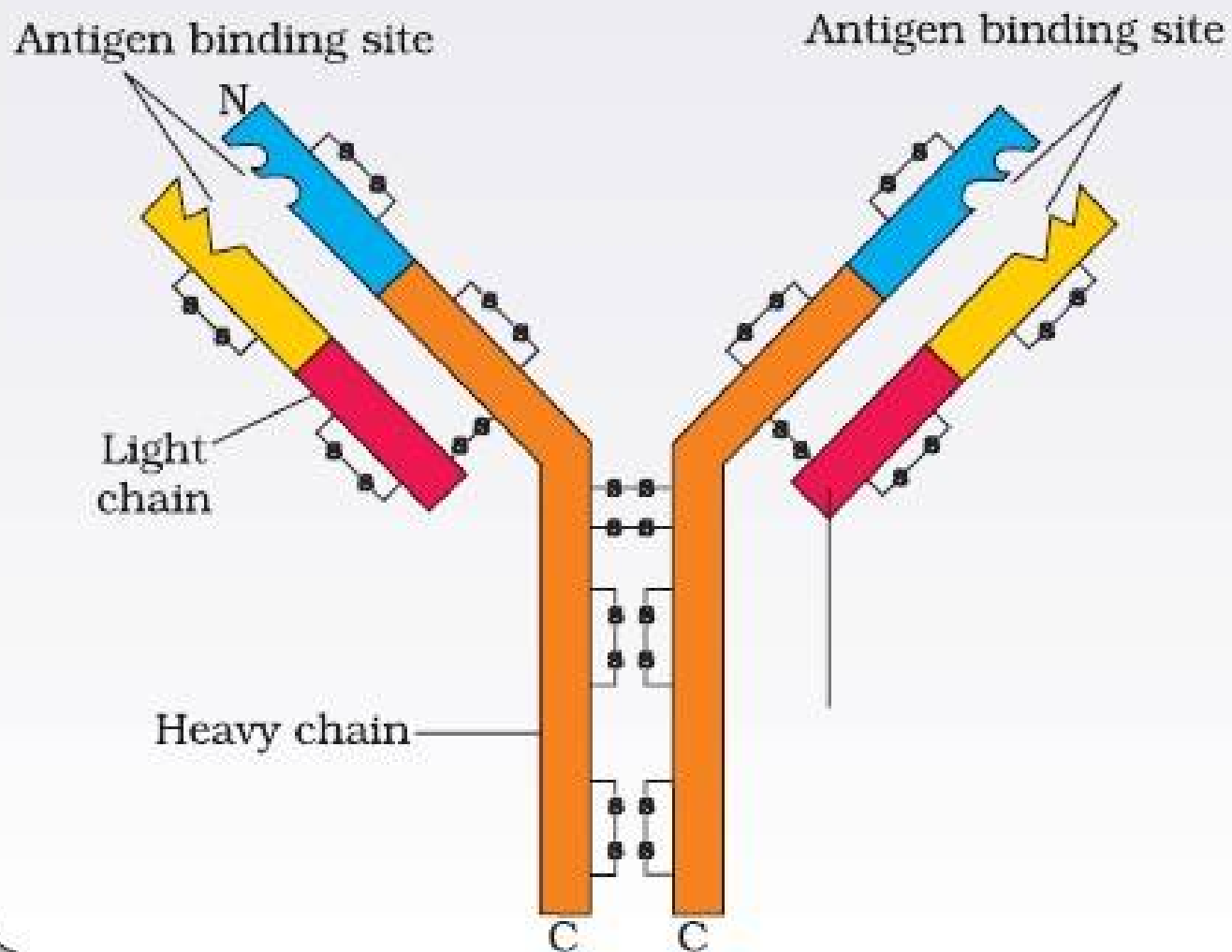


2. AMI (antibody mediated immunity)/ humoral immunity – based on B- lymphocytes (forms and mature in BM)
- ✓ B lymphocytes produce an army of proteins in response to pathogen into blood to fight with them, called antibodies (by plasma cells)
  - ✓ T-cells do not secrete antibodies but help B-cells produce them

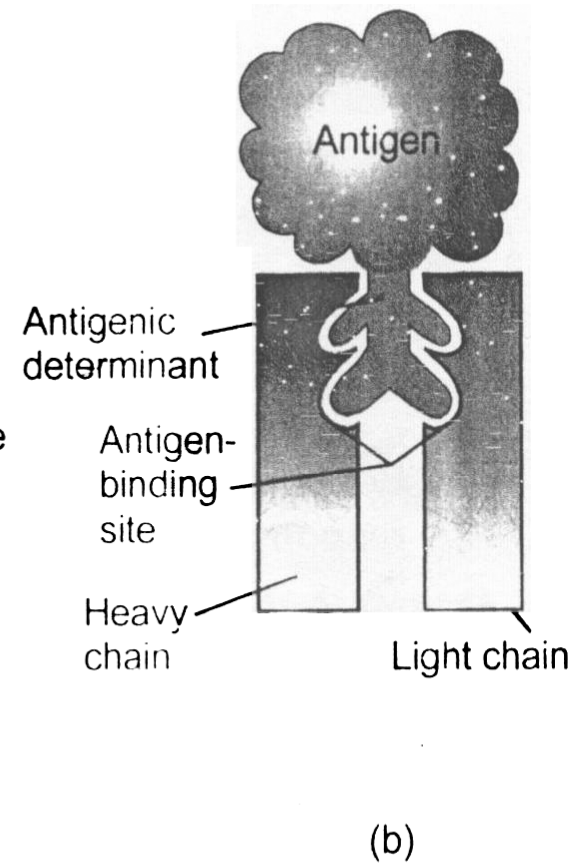
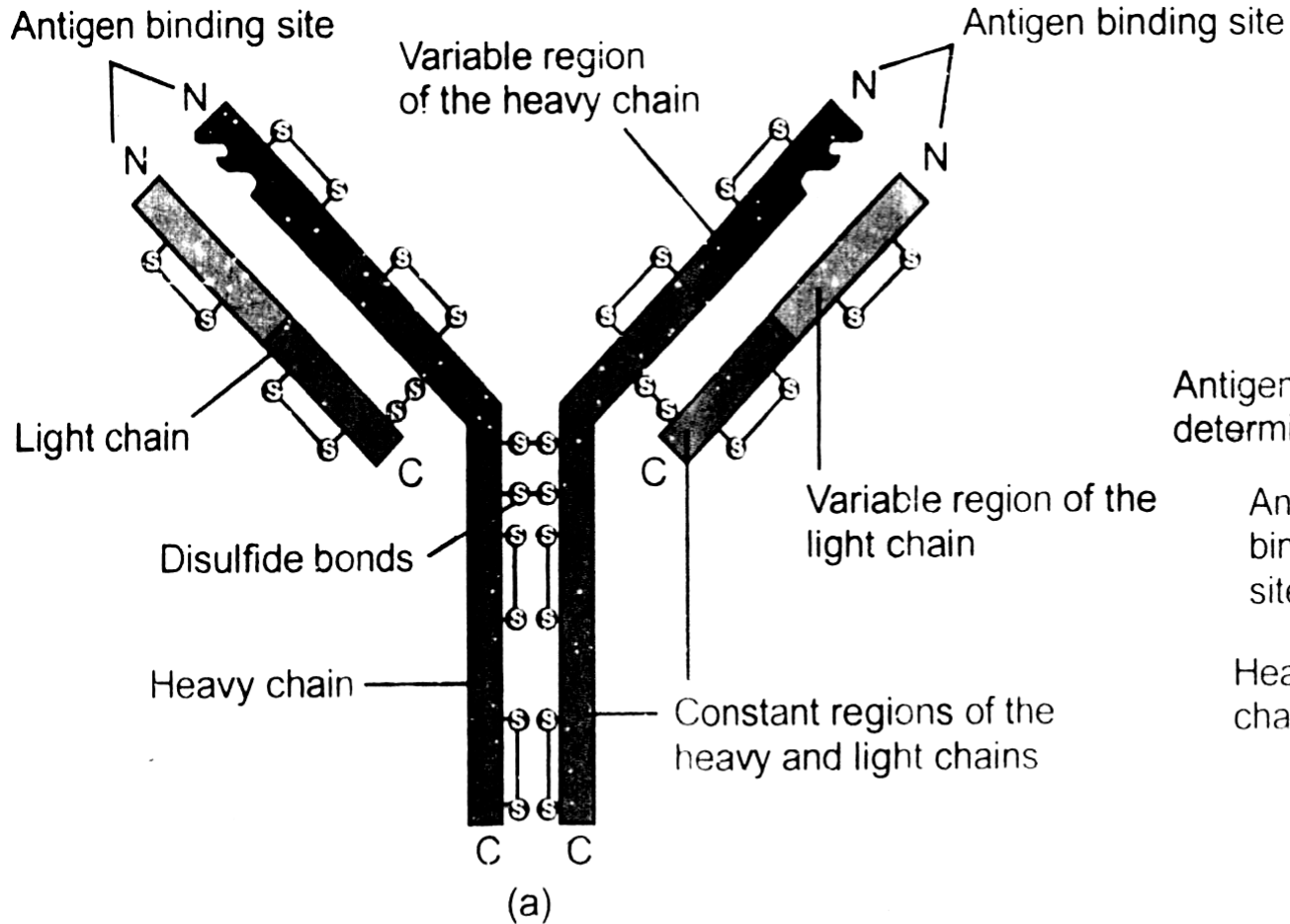
<b>CMI</b>	<b>AMI</b>
<ol style="list-style-type: none"> <li>1. Composed of T-cells (T<sub>H</sub>/T<sub>C</sub>/T<sub>S</sub>/memory T-cells)</li> <li>2. Cytokines/Lymphokines &amp; perforins</li> <li>3. Role in Cancer</li> <li>4. Role in Organ Transplant</li> </ol>	<ul style="list-style-type: none"> <li>- B-cells (Plasma memory &amp; B-cells) (T<sub>H</sub> also helps)</li> <li>- Antibody production</li> <li>- No direct role</li> <li>- No direct role</li> </ul>



- Antigen (antibody generating) - polysaccharide and proteins
  - ✓ Epitope – part of antigen which bind with antibody
- Antibody/ immunoglobulin (Ig)- gamma globulin protein formed by plasma cells (B-lymphocytes), in response to specific antigen
  - ✓ Glycoproteins (96% proteins + 4% carbohydrates)
  - ✓ Structure of antibody –  $H_2 L_2$  (2 small light + 2 longer heavy polypeptide chains)
  - ✓ Because these antibodies are found in the blood, the response is called humoral response
  - ✓ Paratope –antigen binding site on antibody (2 paratopes in each antibody and each paratopes has one  $V_L$  and one  $V_H$ )
  - ✓ Antibody is Y – shaped



**Figure 8.4** Structure of an antibody molecule



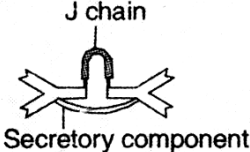



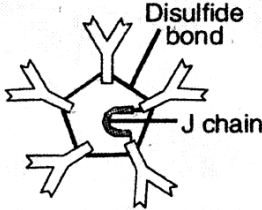
**Fig. :** Immunoglobulins : (a) Structure, (b) Antigen binding site

Different types of antibodies are produced in our body IgA, IgM, IgE, IgG are some of them.

## ➤ **Types of antibodies -5**

1. IgG- maximum (75-80%), cross placenta, monomer
2. IgA- 10-15% (second max.), present in colostrums, saliva tear etc, called secretory/ serum Ab, dimer
3. IgM-7%, pentamere, first anti body formed in fetal life, largest antibody, first antibody formed during primary immune response
4. IgD- <1%, monomer, present on inactive B - cells (acts as antigen receptors on surface of inactive B cells)
5. Ig E - <0.5% - minimum, monomer, increased during allergy (stimulates mast cells and basophil to secrete histamine), and helmenthic infections (activates eosinophil)

## Summary of Human Immunoglobulins (Antibodies)

Characteristics	IgA	IgD	IgE	IgG	IgM
					
<b>Structure</b>	Dimer (with secretory component) and J-chain	Monomer	Monomer	Monomer	Pentamer with J chain
<b>Percentage of total serum antibody</b>	10–15%	0.2%	Less than 0.1%	80%	5–10%
<b>Location</b>	Secretions (tears, saliva, mucus, intestine, colostrum), blood, lymph	B cell surface, blood, lymph	Bound to mast and basophil cells throughout body, blood	Blood, lymph, intestine	Blood, lymph, B cell surface (as monomer)
<b>Function</b>	Localized protection in external secretions (tears, intestinal secretions, etc.)	Antigen recognition by B cells	it is involved in allergic reactions <i>• Can fight against worms (ADCC)</i>	Complement activation	Complement activation
<b>Placental transfer</b>	No	No	No <i>↓ Ab dependent</i>	Yes	Yes



➤ Ag – Ab reactions –

1. Neutralisation
2. Agglutination – eg. Mismatched blood transfusion
3. Cytotoxic reaction – opsonization, compliment fixation, activation of NK – cells
  - ✓ Note: IgE activates eosinophil which destroy helminthes

## ➤ **Types of acquired immunity –**

**1. Active** – when a host is exposed to antigens, which may be in the form of living or dead microbes or other proteins, antibodies are produced in the host body

Slow and takes time to give its full effective response

a) natural active – casual sickness after disease

b) artificial active – vaccination/  
immunization(injecting microbes deliberately  
during immunization)

**2. Passive** – when readymade antibodies are directly given to protect the body against foreign agents

a) natural passive – colostrum (IgA) and IgG(fetus receives from mother through placenta during pregnancy)

b) artificial passive – anti- tetanus serum, anti-diphtheria serum etc

**Note** – father of active immunity- Edward Jenner (small pox vaccine)

father of passive immunity – Von Behring

<b>Active Immunity</b>	<b>Passive Immunity</b>
<ol style="list-style-type: none"> <li>1. Ab formed by own immune system</li> <li>2. Slow response</li> <li>3. Long – Lasting Effect</li> <li>4. No. side – effects</li> <li>5. Eg. – Vaccines</li> </ol>	<ul style="list-style-type: none"> <li>- Readymade Ab</li> <li>- Fast</li> <li>- Short-term effect</li> <li>- Chances of foreign body reactions</li> <li>- ATS, ADS, Anti-snake venom</li> </ul>

### Difference between active and passive immunity

Active immunity		Passive immunity	
1.	Produced actively by the immune system of host.	1.	Received passively by the host and the host's immune system does not participate.
2.	Induced by infection or by contacts with immunogen, e.g. vaccines.	2.	Conferred by introduction of ready-made antibodies.
3.	Immune response-durable and effective.	3.	Immune response-short lived and less effective.
4.	Immunity develops only after a lag period.	4.	Immunity effective immediately.
5.	Immunological memory present.	5.	No immunological memory.
6.	Serves no purpose in immunodeficient host.	6.	Applicable in immunodeficient host.
7.	Used for prophylaxis to increase body resistance.	7.	Used for treatment of acute infection.

- Vaccination – based on property of memory of immune system
  - ✓ Provide artificial active immunity
  - ✓ A preparation of antigenic proteins of pathogens or inactivated /weakened pathogen (vaccine) are introduced into body
  - ✓ Antibodies produced in the body against these antigens would neutralize pathogenic agents during actual infection
  - ✓ Vaccine also generates memory B and T – cells that recognize the pathogen quickly on subsequent exposure and overwhelm invaders with a massive production of antibodies
  - ✓ If a person is infected with some deadly microbes to which quick response is required as in tetanus, direct injection of preformed antibodies or antitoxin (preparation containing antibodies to the toxin) - passive immunization. Also in case of snake bites

### Differences between Vaccine and Antiserum

#### *Vaccine*

1. Vaccine is a preparation of attenuated (weakened) or dead pathogens of a disease.
2. It provides active immunity, that lasts for longer period.

#### *Antiserum (pl. Antisera)*

1. Antiserum is serum that contains antibodies, usually from an animal that has been deliberately exposed to a particular antigen.
2. It provides passive immunity, that lasts for shorter period.

## ➤ Vaccines:

1. Whole organism –
  - a) Live but weakened/ attenuated pathogen – MMR, BCG, OPV, small pox, chicken pox etc
  - b) Killed /inactivated pathogen – IPV/ Salk vaccine, rabies, typhoid etc
2. Subunit of organism – diphtheria toxoid , tetanus toxoid etc
3. Recombinant vaccine (genetic engineering/ rDT) – allowed production of antigenic polypeptides of pathogens in bacteria or yeast, allow large scale production and greater availability
  - ✓ Eg. Hepatitis B vaccine (second generation) produced from yeast, HPV vaccine
4. DNA vaccine (3<sup>rd</sup> generation)



## **Abbreviations of Some Vaccines**

<b>BCG</b>	– Bacillus Calmette – Guerin
<b>OPV</b>	– Oral Polio Vaccine
<b>DPT</b>	– Diphtheria, Pertussis Tetanus
<b>MMR</b>	– Measles, Mumps Rubella
<b>HAV</b>	– Hepatitis A Virus
<b>HBV</b>	– Hepatitis B Virus
<b>HIB</b>	– H influenzae B vaccine
<b>Australia Antigen</b>	– Another name for the ‘hepatitis B antigen which was first discovered in the blood of an Australian aborigine (tribe)
<b>TAB</b>	– Typhoid paratyphoid A and B vaccine
<b>TABC</b>	– Typhoid paratyphoid A and B and cholera vaccine
<b>ATS</b>	– Antitetanus Serum

## ➤ **Auto immunity –**

- ✓ Memory based acquired immunity evolved in higher vertebrates based on the ability to differentiate foreign organism like pathogens from self- cells .
- ✓ Due to genetic or unknown reasons, body attacks self - cells (Ab being formed against body cells)

1. Rheumatoid arthritis – synovial membrane of joints
2. Type 1 diabetes (IDDM) – beta cells of pancreas
3. Myasthenia gravis – neuromuscular junction/ motor end plate
4. Hashimoto's thyroiditis – follicular cells of thyroid gland
5. Multiple sclerosis – myelin sheath of nerve cells

- Immune deficiency disease – AIDS (attacks helper T - cells), SCID (lack of ADA gene)
- Hypersensitivity/ allergy –
  - ✓ Exaggerated response of immune system to certain antigens present in environment (allergens- mites in dust, pollens, animal dander etc)
  - ✓ Antibodies produced – IgE
  - ✓ Due to release of histamine and serotonin from mast cells
  - ✓ Symptoms – sneezing, running nose, watery eyes, itching difficulty in breathing

- ✓ To determine cause of allergy – patient is exposed to or injected with very small doses of possible allergens and the reactions are studied
- ✓ Treatment – anti- histamine drugs, adrenaline, steroids
- ✓ Modern life style has resulted in lowering of immunity and more sensitivity to allergens – more and more children in metro cities of India suffer from allergies and asthma. This could be because of protected environment provided early in life
- ✓ Hay fever (allergy of pollens), asthma (spasm of bronchioles), urticaria, eczema etc
- ✓ Anaphylactic shock – most severe allergic reaction (histamine – vasodilation and increased permeability of blood vessel – fluid leaks out – decrease in blood volume and BP – leads to death)

➤ Grafting / implantation of organ (basis – source of graft):

1. Autograft – between 2 parts of same body
  2. Isograft – between 2 identical twins
  3. Allograft between 2 individual of same species
  4. Xenograft – between 2 individual of different species
- ✓ Chances of rejection –  $4 > 3 > 2 > 1$
  - ✓ Preference for donor – identical twins > siblings > parents > blood relatives
  - ✓ Tissue matching (HLA), blood group matching essential before any graft/ transplant
  - ✓ Prevention of donor rejection-immunosuppressant drugs all through life (eg, cyclosporine, azothioprene)

- Alcohol and drug abuse:
  - Prevention and control
    - ✓ Such habits are more taken up during adolescence
    - ✓ Parents and teachers have special responsibility
    - ✓ Parenting combines with high levels of nurturance and consistent discipline is associated with lowered risk of substance (alcohol, drugs/ tobacco) abuse
  - 1. Avoid undue peer pressure
  - 2. Education and counseling – channelize child's energy into health pursuits like sports, reading, music, yoga etc
  - 3. Seeking help from parents and peers
  - 4. Looking for danger signs
  - 5. Seeking professional and medical help – qualified psychologist, psychiatrist, de-addiction and rehabilitation programs

- drug abuse –
- ✓ Any chemical with medicinal property, when taken for purpose other than medical use or in amounts/frequency that impairs one's physical, physiological or psychological function constitutes drug abuse
- 1. Psychotropic drugs /mood altering drugs – eg. Tranquilizers and sedatives (hypnotics), opiate narcotics, coca alkaloids
- 2. Psychodelic / hallucinogenic drugs
- Tranquillizers and sedatives –
- ✓ Depress CNS, relaxation of body and calmness, induce sleep (sleeping pills), used for treatment of insomnia eg. Barbiturates, benzodiazepenes (vallium)

## ➤ **Stimulants:**

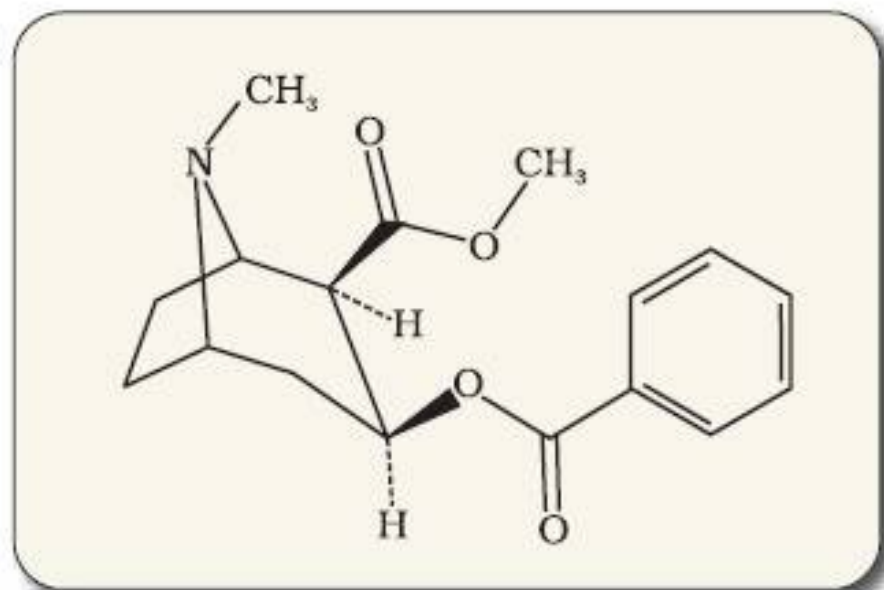
- ✓ Stimulates/ excite CNS, inhibit sleep, hunger, thirst, apathy (no salivation), false confidence increased energy
- Mild stimulants-caffeine (tea, coffee, cold drinks, chocolates)
- Strong stimulants –
  1. Amphetamines – meth (synthetic analogue of adrenaline)
  2. Cocaine /coke /coca alkaloid/crack
    - ✓ From leaves of coca plant *Erythroxylum coca* (native to south America), usually snorted
    - ✓ Interferes with transport of neurotransmitter dopamine
    - ✓ Potent stimulating action on CNS, producing sense of euphoria and increased energy.
    - ✓ Excessive dosage of cocaine causes hallucination
    - ✓ Hallucinogenic properties are also found in *Atropa belladonna* and *Datura*





**Figure 8.11** Flowering branch of *Datura*

- Opiate narcotics – pain killers/ analgesic, bind to opioid receptors in CNS and GIT
  - ✓ Generally taken by snorting and injection
  - ✓ Opium, white latex from unripened fruits of poppy plant (*Papaver somniferum*) – various alkaloids
    1. Codein- cough syrups (mild)
    2. Morphine – very effective sedative and pain killer, very useful after surgery
    3. Heroin /smack- diacetylmorphine (white, colourless, bitter crystalline compound, obtained by acetylation of morphine), most potent opiate, depress CNS and slows down body functions

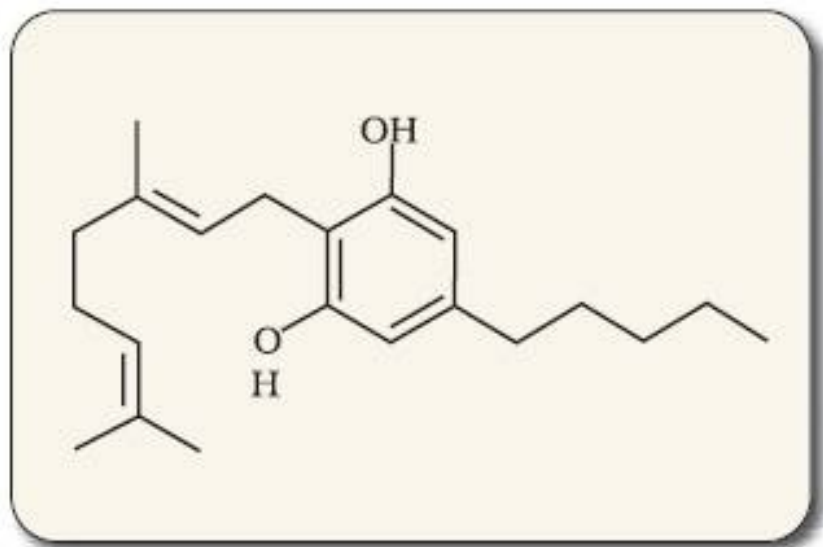


**Figure 8.7** Chemical structure of Morphine



**Figure 8.8** Opium poppy

- Psychedelic drugs – hallucinogens, alter feeling thoughts perceptions without any sensory stimulus
  1. LSD (Lysergic acid diethyl amide) – most potent hallucinogen, obtained from *Claviceps purpurea* (ergot fungus)
  2. Psilocybin – from mushroom
  3. Mescaline from cactus
  4. Cannabinoids – interact with cannabinoid receptors in brain obtained from all parts of hemp plant/ *cannabis sativa*
    - ✓ Leaves – bhang
    - ✓ Dried female flowers -marijuana (ganja)
    - ✓ Resinous extract of stigma- hashish/ charas
    - ✓ Generally taken by inhalation and oral ingestion
    - ✓ Effects on cardiovascular system of body
    - ✓ Note- most commonly drugs used for abuse –
- 1. Cocaine/ crack (CNS stimulant)
- 2. Heroine/ smack (opiate narcotic, CNS depressant)
- 3. Cannabinoids (hallucinogens, effects CVS)



**Figure 8.9** Skeletal structure of cannabinoid molecule



**Figure 8.10** Leaves of *Cannabis sativa*

- Smoking – tobacco used for more than 400 years (smoked, chewed or snuffed)
- Tobacco contains nicotine, an alkaloid
- Nicotine stimulates adrenal gland – release adrenaline and non- adrenaline, increase BP and increase heart rate
- Tobacco chewing – increase risk of cancer of oral cavity
- Smoking – increased incidence of cancers of lung, urinary bladder and throat, bronchitis, emphysema, coronary heart disease gastric ulcer etc.
- Smoking increase CO in blood and reduce concentration of haembound oxygen – causes oxygen deficiency in body
- Any addict requires counseling and medical help to get rid of the habit

## Major Categories of Psychoactive Drugs, their Effects and Clinical Uses

Type of Drug	Examples	Effects	Clinical Uses
Sedatives and tranquillisers (depressants)	Barbiturates Benzodiazepines (e.g., Valium)	Depress brain activity and produce feelings of calmness, relaxation, drowsiness and deep sleep (high doses)	Hypnotic, antianxiety
Opiate narcotics	Opium, morphine, heroin, pethidine, methadone	Suppress brain function, relieve intense pain (physical and mental), produce temporary euphoria	Analgesic
Stimulants	Caffeine (very mild), amphetamines (including dexamphetamine), cocaine and its derivative Novacaine	Stimulate the nervous system; make a person more wakeful, increase alertness and activity, produce excitement	Attention deficit, Narcolepsy, weight control
Hallucinogens	LSD, mescaline, psilocybin, (charas, hashish, marijuana bhang) Cannabinoids	Alter thoughts, feelings and perceptions; hallucinations	None

## **Mental health and disease – 3 types**

1. Neurosis – ordinary illness, pt is aware and ready to seek help. eg. anxiety, fear etc
2. Psychosis – severe, pt not aware and not ready to seek help
  - a) Alzheimer's disease – progressive loss of memory, due to decreased Ach
  - b) Schizophrenia- split personality, auditory hallucination, dementia etc, due to excess dopamine
  - c) Parkinsons disease – loss of control over motor activity, due to decreased dopamine (tremors in limbs /neck etc)

Note - epilepsy – recurrent seizures



## ➤ **Adolescence and drug/ alcohol abuse:**

- ✓ Adolescence means both a period and a process during which a child becomes mature in terms of his or her attitudes and beliefs for effective participation in society (12-18 years of age – bridge linking childhood and adulthood)

## ➤ **Addiction and dependence:**

1. Psychological dependence – like euphoria/ temporary feeling of well being etc
2. Physical/ physiological dependence (neuroadaptation) -
  - ✓ With repeated use of drugs, tolerance level of receptors of body increases
  - ✓ Receptors respond only to highly doses leading to greater intake and addiction
  - ✓ Dependence is the tendency of body to manifest a characteristic and unpleasant withdrawal syndrome, if regular dose of drug / alcohol is abruptly discontinued
  - Withdrawal syndrome - anxiety, shakiness, nausea, sweating, running nose, muscle tremors etc (can be even life threatening)

➤ **Alcohol abuse –**

- ✓ Ethyl alcohol
- ✓ In liver, ethyl alcohol converted to acetaldehyde (more toxic)
- ✓ Effects of alcohol –
- ✓ On chronic use – CNS (cerebellum) and liver effected

1. CNS – suppress CNS , particularly effects cerebellum (ataxia/ abnormal gait, dysarthria, weakness of reflexes, reaction time increase, darkens peripheral vision)
  - ✓ Wernicks Encephalopathy and korsakoffs psychosis
2. Liver
  - ✓ Fatty liver (fat deposition in hepatocyte), hepatomegaly, jaundice, alcoholic hepatitis, cirrhosis (shrinkage and fibrosis of liver), liver cancer
3. Kidneys- increased urine output due to ADH hyposecretion
4. Dehydration, hypoglycemia, gastritis, peptic ulcer, gastric carcinoma, atherosclerosis, increased BP and HR
5. Fetal alcohol syndrome , if taken in pregnancy

## ➤ **Effects of drug / alcohol abuse –**

1. Behavioural and psychological changes
2. Social effect - stealing, family agony
3. AIDS and hepatitis B – intravenous drug users by sharing infected needles and syringes
4. Damage to fetus in pregnancy
5. On chronic use – CNS and liver damage (cirrhosis)
6. Misuse of drugs by sports person to enhance performance-
  - ✓ Narcotic analgesics, anabolic steroids, diuretics, hormones like erythropoietin – increase muscle strength and bulk, promote aggressiveness

➤ **Anabolic steroid(side effects):**

- a) In females – masculinization (features like males), increased aggressiveness, mood swings , depression, abnormal menstrual cycle , excessive hair growth on face and body, enlargement of clitoris, deepening of voice
- b) In males – acne, increased aggressiveness, mood swings, depression, reduced size of testicles, decreased sperm production, kidney and liver dysfunction, breast enlargement, premature baldness , enlargement of prostate gland
- c) In both male and female – severe facial and body acne, premature closure of growth centers of long bones (stunted growth)

## ➤ **Effects of drug /alcohol abuse –**

- ✓ Immediate adverse effects- reckless behavior, vandalism, violence
- ✓ Excessive dose – coma and death due to respiratory failure, heart failure or cerebral hemorrhage
- ✓ Combination of drugs or their intake along with alcohol results in overdosing and death
- ✓ Most common warning signs among youths – drop in academic performance unexplained absence from schools/ collage, lack of interest in personal hygiene, withdrawal, isolation, depression, fatigue, aggressive behavior, deteriorating relationship, lost of interest in hobbies, change in sleeping and eating habits, fluctuations in weight, appetite, etc.